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NOTES ON TREES AND SHRUBS OF MISSOURI

By BENJAMIN FRANKLIN BUSH.

Review of Swallow's Trees and Shrubs of Missouri.

I have just received a book entitled "Geological Report of the Country along the line of the South-western branch of the Pacific Railroad, State of Missouri," prepared by G. C. Swallow, State Geologist of Missouri, assisted by B. F. Shumard and G. C. Broadhead.

This report apparently was prepared during 1857 and 1858 and was finished on June 2, 1858, and deals primarily with geological matters, building stone, lime, soils, water, clays, minerals and other products that were of more commercial importance to the railroad about to be constructed; and secondly, with a dissertation on the native species of *Vitis;* a notice of the timber, trees, shrubs and vines that occur in the region contributory to the line of the railroad, by G. C. Swallow, B. F. Shumard and G. C. Broadhead; and a catalogue of trees and shrubs found in the Counties in the territory included in the plan of the survey, by G. C. Swallow, State Geologist.

This survey began in Saint Louis county, and passed through Washington, Jefferson, Franklin, Maries, Moniteau, Taney, Vernon, Camden, Gasconade, Laclede, Phelps, Pulaski, Dallas, Polk, Saint Charles, Ste. Genevieve, Cape Girardeau, Dent, Dade, Barton, Crawford, Wright, Stone, Webster, Pemiscot, Greene, Barry, Lawrence, Jasper and Newton Counties and ended in McDonald County, 32 counties in all.

Title on the cover reads "South West Branch," but the title

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on the frontispiece reads "South-western Branch," and I have accepted this last.

The portion dealing more or less with trees and shrubs is divided into three parts, the first, by G. C. Swallow, beginning on page 11, and ending on page 23, is a dissertation on the native species of *Vitis* of Missouri, the cultivation thereof, and the making of wine; the second part, beginning on page 74 and ending on page 76, is a short notice of the principal trees, shrubs and vines observed during the course of the survey by G. C. Swallow, B. F. Shumard and G. C. Broadhead, in several Counties in Missouri; and the third part is a catalogue of the trees and shrubs found in the Counties which were included in the survey, by G. C. Swallow.

Beginning with the first part, I note that Swallow lists seven species of *Vitis* for the region included in the survey, as follows: *Vitis Labrusca*, Fox Grape, *V. aestivalis*, Summer Grape, *V. cordifolia*, Winter Grape, *V. riparia*, River Grape, *V. vulpina*, Muscadine, *V. bipinnata* and *V. indivisa*.

Of *V. Labrusca*, Swallow says it is common in all parts of the State, but this species does not occur in Missouri, and I am compelled to believe that Swallow must have mistaken some form of *V. aestivalis* for this species, or possibly the form that I now take to be *V. Linsecomii glauca*, which is common in Carter, Reynolds, Shannon, Texas, Wright, Webster, Greene, McDonald and Newton Counties.

Swallow included *V. bipinnata* and *V. indivisa* in his report on the native species of *Vitis*, but these are not grapes at all, and he should have included *Vitis quinquefolia* along with them, as this species is as much a grape as they, and he does list it in the catalogue on page 83. On page 16 Swallow says "from this list it will be seen that Missouri possesses all the native grapes of our country save one, the *Vitis Caribaea* D. C., of California."

This statement is certainly remarkable, inasmuch as Swallow does not list *Vitis rubra* Michx., and *V. rupestris* Scheele, known Missouri species, and *V. Caribaea* D. C. is a Gulf Coast species, and not found in California, as so stated by him.

On pages 74 and 75 under the head of timber, Swallow gives a list of some 42 species of trees, shrubs and vines, for the most part correctly identified, as follows: *Acer saccharinum, A. barbatum glaucum, Aesculus* sp., *Asimina triloba, Betula nigra, Carya alba, C. ovata, C. laciniosa, C. amara, Cercis canadensis, Corylus americana, Celtis* sp., *Fraxinus americana, F. quadrangulata, F. sambucifolia, Gleditschia triacanthos, Juglans nigra, J. cinerea, Morus rubra, Negundo aceroides, Prunus americana, Maclura pomiferum, Prunus serotina, Platanus occidentalis, Quercus alba, Q. marilandica, Q. stellata, Q. macrocarpa, Q. rubra, Q. bicolor, Q. velutina, Q. palustris, Q. imbricaria, Q. falcata, Q. Muhlenbergii, Rhus* sp., *Ulmus americana, U. fulva, U. alata, Vitis rotundifolia, V. aestivalis,* and *V. Labrusca.*

As I have stated above, this list of names is mostly correctly given, the only ones I object to are *Prunus americana, Fraxinus sambucifolia* and *Vitis Labrusca,* the last of these I have alluded to under *Vitis* in the first part of this report we are dealing with.

At this place it may be observed that it is rather remarkable that during all the years that Swallow and Broadhead were studying the geology and palaeontology of Missouri, and observing and making notes on trees and shrubs and plants of the State, that they never found a new species, or had a species named for either one or the other.

On page 75 under the head of timber are some abstracts from B. F. Shumard's County reports, of Crawford, Phelps, Pulaski and LaClede Counties, which enumerate some of the principal trees and shrubs observed, some 21 species in all, nearly all of them correctly named as follows: *Acer barbatum glaucum, A. saccharinum, Celtis* sp., *Carya alba, C. ovata, C. amara, Cornus* sp., *Asimina triloba, Gleditschia triacanthos, Juglans nigra, J. cinerea, Quercus alba, Q. coccinea, Q. macrocarpa, Q. stellata, Q. velutina, Q. marilandica, Sambucus canadensis, Tilia* sp., *Ulmus americana* and *U. fulva.*

The only doubtful name in this short list of species is that of the Scarlet Oak, which I can scarcely believe was known

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to Shumard at that time, as it was some sixty years later that this species was definitely shown to occur in the State, after years of search, and an intensive study of *Quercus* species.

It is interesting to note here that some two years later, Prof. Buckley dedicated *Quercus Shumardii* to Mr. Shumard, a conspicuous oak of the swamps and lowlands of the southeastern part of Missouri to Louisiana and Texas.

It is very evident that Shumard did not attempt to give anything but a general view of the woody species of these Counties, as the presence of such conspicuous trees and shrubs as *Quercus rubra, Q. bicolor, Q. Muhlenbergii, Q. imbricaria, Cercis canadensis, Gymnocladus dioica, Ostrya virginiana, Carpinus caroliniana, Juniperis virginiana, Diospyros virginiana, Platanus occidentalis, Amelanchier canadensis, Sassafras variifolium, Corylus americana, Negundo aceroides, Prunus serotina, Tecoma radicans and Betula nigra,* in the Counties under consideration would attest.

On pages 75 and 76 is given a short abstract from Broadhead's notes on the trees and shrubs found in several Counties included in the survey. No attempt is made to give a complete list of the species observed. The following list enumerates 31 species of trees and shrubs observed, all perhaps correctly identified.

Asimina triloba, Alnus rugosa, Carpinus caroliniana, Celtis sp., *Carya ovata, C. amara, Corylus americana, Cercis canadensis, Fraxinus* sp., *Juglans nigra, J. cinerea, Morus rubra, Nyssa aquatica, Ostrya virginiana, Prunus* sp., *Platanus occidentalis, Quercus alba, Q. Muhlenbergii, Q. stellata, Q. velutina, Q. imbricaria, Q. macrocarpa, Q. rubra, Q. bicolor, Q. prinoides, Sassafras variifolium, Tilia* sp., *Ulmus americana, U. fulva, Vitis* sp., and *V. rotundifolia.*

That these lists of trees and shrubs observed by Swallow, Shumard and Broadhead, were not made from notes in the field, but probably from memory, is conclusively proven by the many omissions of conspicuous trees and shrubs which could not have been overlooked. Chief among these perhaps, in point of commercial value, utility and attraction, is the Yellow

Pine, *Pinus echinata,* which was abundant in many of the Counties of the Ozark Uplift; the Bald Cypress, *Taxodium distichum,* common in swamps along the Mississippi River from Cape Girardeau County to Pemiscot County; the Red Cedar, *Juniperus virginiana,* so common on bluffs and cliffs along rivers, and in cedar-glades in many of the Ozark Counties; the Cottonwood, *Populus virginiana,* often abundant in the deep bottoms of the Mississippi River from Saint Louis County to Pemiscot County; the Pecan, *Carya Pecan,* often very common along streams in southern Missouri, could scarcely have been overlooked; the Persimmon, *Diospyros virginiana,* so common in groves on the prairies of Southern Missouri; the Sweet Gum, *Liquidambar Styraciflua,* so common in bottoms, and so much sought after by saw-mill men for lumber; the Tupelo, *Nyssa uniflora,* abundant in swamps along the Mississippi River from Cape Girardeau County southward to Pemiscot County.

Among the more notable trees and shrubs of Southern Missouri which were of not much commercial importance, the following named could hardly have been overlooked in the field, and I do not see how these observers could have missed recording such conspicuous species as *Bumelia lanuginosa, Gymnocladus dioica, Quercus Michauxii, Q. lyrata, Q. aquatica, Fraxinus lanceolata, Ilex opaca, Viburnum rufidulum, Aralia spinosa, Rhamnus caroliniana, R. lanceolata, Robinia Pseudacacia, Malus* species, *Crataegus mollis, C. viridis, C. Phaenopyrum* and *Carya aquatica.*

On page 76 begins the Catalogue of Trees and Shrubs, ending on page 83, and enumerates 120 species of shrubby plants observed in the 32 Counties included in the survey, which is a very short list, considering that we now know more than five hundred species of woody plants for the State. This catalogue shows many evidences of haste, carelessness and negligence in its preparation, and it represents about as much work as could be done in several days by a trained collector.

For convenience of reference I have numbered the names in this catalogue, and will make notations on such species as

seem to me to merit this, and also call attention to some notable omissions of species that could hardly have escaped notice in making this survey.

1. COMMON ALDER, *Alnus serrulata.*

Swallow records this species from Newton, Lawrence and Taney Counties, but its known range in Missouri is from Lewis, Lincoln and Marion Counties to McDonald County, along the banks of rocky streams.

2. BLACK ALDER, OR WINTER BERRY.

I presume Swallow meant *Ilex verticillata* when he wrote that, but I can not believe he knew that species at the time, as it is very rare and local in Missouri. This species is listed in Tracy's Catalogue as having been found in Boone, Iron, Mississippi, and Pike Counties, but the records were so doubtful that I did not include it in my Trees, Shrubs and Vines of Missouri.

Perhaps Swallow had in mind *Rhamnus lanceolata* which is so often mistaken for *Ilex verticillata.*

Two trees that escaped Swallow's notice, *Rhamnus lanceolata* and *R. Caroliniana,* are common in many places in the Counties covered by this survey.

The strikingly conspicuous Holly, *Ilex opaca,* is common in some places in Pemiscot County, but Swallow overlooked it.

3. CRAB APPLE, *Malus coronaria.*

It is impossible now to tell which of the five or six species of *Malus* known to occur in Missouri that Swallow had, but it certainly was not *M. coronaria,* which is an eastern species.

4. WHITE ASH, *Fraxinus americana.*

Swallow merely cites Maries County for this species, but it is found in every County in Missouri, mostly in upland woods that are rather dry.

5. BLUE ASH, *Fraxinus quadrangulata.*

No particular locality is cited for this species, but it ranges from the northeast to the southwest corner of the State. Swallow overlooked the Green Ash, *Fraxinus lanceolata,* which is

common along all the streams in the State, and another species, *Forestiera acuminata*, is common from the Meramec River to Newton County, along the banks of streams. Another interesting tree, *Bumelia lanuginosa*, occurs in rocky upland woods in all the Ozark Counties.

Swallow negligently overlooked the Black Ash, *Fraxinus sambucifolia*, in his catalogue, for he lists this species in his remarks on timber on page 75.

6. PRICKLY ASH, *Zanthoxylum americanum*.

The habitat for this species is given by Swallow as bottoms and moist places, but I have usually found this shrub on dry wooded hills and in upland woods along streams. See No. 120.

7. AMERICAN LINDEN, *Tilia americana*.

At the time Swallow prepared his Catalogue it was supposed that all the glabrate Lindens of this State were *T. americana*, but I suspect that most of the trees observed by him were *T. alabamensis* Ashe, which is the common species of Southern Missouri.

The very peculiar shrub, *Dirca palustris*, common in many places in southern Missouri, Swallow evidently overlooked. Another interesting species, *Aralia spinosa*, found in Pemiscot County, was also overlooked by Swallow.

8. RED BIRCH, *Betula nigra*.

This species is common along streams from Clark County to McDonald County, but is absent in the Northwestern part of the State.

9. DEWBERRY, *Rubus canadensis*.

The common, widely diffused Dewberry, *Rubus flagellaris*, found throughout Missouri, undoubtedly was the species Swallow found.

10. WEDGE-LEAVED BLACKBERRY, *Rubus cuneifolius*.

I am unable to guess what species Swallow had in mind, but it certainly was not *R. cunefolius* which is a species of the

Southeastern States. Tracy in his catalogue credits this species to Pike County, on authority of Pech, but Pech evidently erred in naming his specimens or else he collected them in some other State.

11. BLADDER-NUT, *Staphylea trifolia.*

Common in nearly every County in the State, and no doubt correctly understood by Swallow.

12. LARGE BUCKEYE, *Aesculus lutea.*

Evidently based on trees of *Ae. glabra,* which is the common and abundant species throughout central Missouri. *Aesculus lutea* does not occur so far West as this State, although Tracy in his catalogue under the name of *Aesculus flava,* says it is common.

The conspicuous, scarlet-flowered species, *Ae. discolor mollis,* common in Pemiscot County and other Counties in southeastern Missouri, could hardly have been overlooked, and yet Swallow missed it.

13. HUCKLEBERRY, *Vaccinium* sp.

No doubt based on plants of the genus *Vaccinium,* more than likely on *V. stamineum,* which is not really a Huckleberry or even a Blueberry, and the only species this could be, as it is common on flint hills in all the Ozark Counties.

14. BLUEBERRY, *Vaccinium vacillans.*

Swallow says this is common on flint hills in Taney and Greene County, but it is common throughout the Ozark region. *V. arboreum,* also common throughout the Ozark Counties, seems to have been missed by Swallow.

15. BOX ELDER, *Negundo aceroides.*

Rightly understood by Swallow, and abundant in low ground throughout the State.

16. BURNING BUSH, *Euonymus atropurpureus.*

Also rightly understood by Swallow, and more or less common throughout the State in shaded ground along streams. Two other species of *Euonymus, E. americanus* and *E. obo-*

vatus, are more or less common in eastern and southern Missouri, particularly Pemiscot County.

17. SYCAMORE, *Platanus occidentalis.*

Common along all the streams of the State. See No. 96.

18. BUTTON BUSH, *Cephalanthus occidentalis.*

Swallow says this is not very abundant, but my observations have shown me that it is often abundant, especially in the lowlands and swamps along the Mississippi River from Cape Girardeau County southward, where I have seen hundreds of acres of it in one swamp. It is called Elbow Bush and Knee Bush by the hunters and fishers in that region.

19. RED CEDAR, *Juniperus virginiana.*

Common along limestone bluffs of the Mississippi and Missouri Rivers, and common in cedar barrens in all of the Ozark Counties.

20. BLACK CHERRY, *Prunus serotina.*

A common, often very large tree, of all parts of the State, especially in rich woods. Another species, the Choke Cherry, *Prunus virginiana*, ranging from Clark County south to Saint Louis and Benton Counties, mostly along streams, seems to have been overlooked by Swallow.

21. COFFEE TREE, *Gymnocladus canadensis.*

Common in rich woods, nearly throughout the state.

22. COTTON-WOOD, *Populus canadensis.*

A very large tree in the deep bottoms of the Missouri and Mississippi Rivers, rare or occasional in the prairie portions of the State and the Ozark Uplift. Another species, *Populus heterophylla*, overlooked by Swallow, occurs from Cape Girardeau County southward in the bottoms along the Mississippi River.

23. CORAL BERRY, *Symphoricarpos vulgaris.*

Common everywhere in the State, sometimes abundant in the prairie regions.

24. CURRANT, *Ribes* sp.

Swallow says several species, but none of them abundant, but he certainly must have been assuming this when he wrote that, as I have no knowledge of any species of Currant in the State. The only species of *Ribes* called Currant, is *R. odoratum*, which occurs along Swan Creek, Taney County, in one locality only. I can scarcely believe Swallow knew of this at that time. Tracy in his Catalogue says *R. odoratum* is common in rocky woodlands, but that was an error certainly, and I did not know this species for Missouri until 1899.

25. FLOWERING DOGWOOD, *Cornus florida.*

Common from Clark County to McDonald County, mostly in rocky woods.

26. PANICLED DOGWOOD, *Cornus paniculata.*

Common in rocky woods and barrens throughout the State.

27. ROUGH-LEAVED DOGWOOD, *Cornus asperifolia.*

Swallow says this species is not abundant, but my observations have shown me that in the big bottoms along the Missouri and Mississippi Rivers it is very abundant, and it is common along all the streams in the State.

28. SILKY DOGWOOD, *Cornus sericea.*

Common along all the streams in the State, but now known as *C. obliqua* Raf. Another species, *Cornus alternifolia*, was missed by Swallow. It occurs from Clark County to the southwestern corner of the State, mostly along rich shaded bluffs along streams. Still another species, *Cornus stricta*, common in swamps in Pemiscot County, was overlooked by Swallow.

29. COMMON ELDER, *Sambucus canadensis.*

Common throughout the State in low grounds, often treelike in the southeastern Counties, where the stems sometimes attain a diameter of three or four inches.

30. WHITE ELM, *Ulmus americana.*

Found throughout the State in rich soil. Often of immense size, often six or seven feet in diameter.

31. SLIPPERY ELM, *Ulmus rubra.*

Common everywhere in the State, usually in dry or rocky ground.

32. WAHOO ELM, *Ulmus alata.*

Swallow cites this species for Greene County, "scarce, limestone ridges," but this tree is found throughout southern Missouri, and is very common in most Counties, of large size in Pemiscot County, where it seems to prefer swamps and low ground, and usually a tree of good size in McDonald County, but in the Ozark Uplift seems to prefer high rocky ridges and is usually quite shrubby.

33. SUMMER GRAPE, *Vitis aestivalis.*

Swallow says abundant on good soil, but I have never seen this species abundant anywhere in the State or even common. I am assuming that Swallow knew the Summer Grape, unless he mistook *Vitis Linsecomii glauca* for it, as the latter is often common in rocky woods in Southern Missouri.

34. FOX GRAPE, *Vitis Labrusca.*

It is very clear that the plants Swallow had in mind were not *V. Labrusca,* but it is quite likely that they were *V. aestivalis,* which is often mistaken for *V. Labrusca* by inexperienced collectors, or *V. Linsecomii,* the latter common in some places in Newton and McDonald Counties in rocky woods.

35. WINTER GRAPE, *Vitis cordifolia.*

Probably correctly identified.

36. MUSCADINE, *Vitis vulpina.*

Not found in Missouri outside of the southeastern Counties, where it is occasionally found in uplands.

37. RIVER GRAPE, *Vitis riparia.*

Probably the plant we now know as *V. vulpina* L., but the habitat is not river banks particularly, and I suspect that the Slough Grape, *V. vulpina praecox* (Engelm.) Bailey, is what Swallow had in mind. Two species of *Vitis* enumerated on page 16, *V. binnata* and *V. indivisa,* are not included in this

catalogue, nor are *V. rupestris*, and *V. rubra*, the former common from Saint Louis County to McDonald County, in rocky or sandy creek beds, the latter common in swamps from Saint Louis County southward along the Mississippi River in swamps.

38. GREEN BRIER, *Smilax rotundifolia.*

Probably correctly identified, but another species, *S. hispida*, even more conspicuous, is not mentioned by Swallow, who must have seen it along some of the rivers where he made the survey.

39. GLAUCOUS GREEN BRIER, *Smilax glauca.*

The habitat given for this species causes me to suspect that Swallow did not have the real *S. glauca* in hand at that time, and most probably mistook plants of *S. rotundifolia* for that species, as the real *S. glauca* is a species of the lowlands of southeastern Missouri, and is called Saw Brier by the natives.

40. *Smilax Pseudo-China.*

I can not imagine what species of *Smilax* Swallow had in mind at that time, as it has been shown that *S. Pseudo-China* is only a form of *S. herbacea*, and *S. herbacea* is an annual-stemmed species and not at all shrubby. As Swallow does not mention *S. hispida*, and Shumard and Broadhead also fail to enumerate it, I venture the guess that Swallow mistook specimens of this species for S. *Pseudo-China.*

41. *Smilax Bona-nox.*

Swallow says this is abundant on shrubs by the fences, but he evidently had some other species in hand, as this species is found only in the extreme southeastern part of the State in cotton fields. Probably only some form of *S. rotundifolia*, which is common in southern Missouri.

42. *Smilax quadrangularis.*

It is very evident that this is only *S. rotundifolia*, the common species in southern Missouri.

43. *Smilax hastata.*

Evidently the same as No. 40, and no doubt based on specimens of *S. rotundifolia*, which is so common in southern Missouri.

44. PRICKLY GOOSEBERRY, *Ribes Cynosbati.*

Swallow says this is abundant, but I have never seen this species common anywhere, as my observations have shown me that it is rare or local on shaded bluffs along streams. Probably Swallow had the common species, *R. gracile*, in hand, since he, Shumard and Broadhead do not enumerate it in their lists, and it is the common species throughout Missouri, and could not have been overlooked.

45. WILD GOOSEBERRY, *Ribes rotundifolia.*

It is very evident that Swallow did not observe this species, and it is not known now from the State, although Tracy has it in his Catalogue in 1886. I am inclined to believe Swallow had *R. gracile* in hand at the time he wrote his catalogue, as that is the common species everywhere in the State.

A large conspicuous tree, the Sweet Gum, *Liquidambar Styraciflua*, evidently neglected by Swallow, could not have been overlooked, as it is common in eastern and southeastern Missouri in sandy bottoms along the Mississippi River. A peculiar shrub, *Hydrangea arborescens*, seems to have been missed by Swallow. It is common in eastern and southeastern Missouri along rich bluffs in the shade.

46. BLACK GUM, *Nyssa multiflora.*

Swallow cites Maries County only for this species, but it occurs from Cape Girardeau County southward and westward to Newton and McDonald Counties. The Tupelo, *Nyssa aquatica*, appears to have been overlooked by Swallow, but it ranges in Missouri from Cape Girardeau County southward along the Mississippi River, in swamps and about ponds.

47. HACKBERRY, *Celtis occidentalis.*

Probably correctly identified as the tree we now know as

C. occidentalis canina, which is the common, large tree throughout the State.

48. HACKBERRY, *Celtis crassifolia.*

There is no evidence that this is the real *C. crassifolia*, and it very probably was the same species as No. 47. The smooth-barked Hackberry, *Celtis laevigata*, seems to have been overlooked by Swallow. It occurs all over Southern Missouri, mostly along streams in rich bottoms.

49. AMERICAN HAZEL, *Corylus americana.*

Probably correctly identified.

50. BLACK HAW, *Viburnum prunifolium.*

Swallow says occurs in open forests in good soil, but he must have had *V. rufidulum* in hand then, since he does not mention that species, which is common in southern Missouri in open woods, while *V. prunifolium* occurs mostly along the banks of rocky streams, and in copses on the prairies.

51. RED HAW, *Crataegus* sp.

By this indefinite term I am supposing that Swallow must have had some edible-fruited species of Thorn in hand, of the *molles group*, or even the *tomentosae* group, but it is impossible at this time to tell which species he had. See remarks under Thorn further on.

52. MOCKERNUT HICKORY, *Carya tomentosa.*

Probably correctly determined.

53. SHELLBARK HICKORY, *Carys alba.*

Swallow says this is not common, but I have found it to be common, almost abundant, on dry hills along streams in the eastern part of the State.

54. THICK SHELLBARK HICKORY, *Carya sulcata.*

No doubt correctly identified.

55. PIGNUT HICKORY, *Carya porcina.*

Swallow says rare on good soil, but I doubt very much if Swallow ever saw the real *C. porcina*, and suspect that some

form of *C. ovalis* must have been seen by him and identified as *C. porcina*.

56. BULLNUT HICKORY, *Carya microcarpa*.

This is probably what we now have as *C. ovalis*, or one of the forms of it, as it is common in just such association as Swallow gives it.

57. BITTERNUT HICKORY, *Carya amara*.

Swallow cites this species from Caps Creek, Newton County, which would seem to signify that it was rare in Missouri, but this species occurs in woods along streams throughout the State. The Pecan, *Carya Pecan*, seems to have been carelessly neglected in this Catalogue. Neither does Shumard or Broadhead mention it in their reports, but it would have been impossible to overlook this tree in the field, as it occurs from Saint Louis to Newton County along streams. Another very interesting species, *Carya aquatica*, found in swamps along the Mississippi from Cape Girardeau County to Pemiscot County, but Swallow does not mention it in this report.

58. YELLOW HONEYSUCKLE, *Lonicera flava*.

It is barely possible that Swallow did find this rare and attractive species, as it really is found in Taney County.

59. SMALL-FLOWERED HONEYSUCKLE, *Lonicera parviflora*.

Probably correctly identified. Another species, and one still more attractive, *Lonicera sempervirens*, occurs in many of the Counties from Saint Louis County to Newton County, mostly along streams.

60. HOP HORNBEAM, *Ostrya virginica*.

Correctly identified.

61. IRONWOOD, *Carpinus americana*.

Also correctly identified.

62. RED BUD, *Cercis canadensis*.

Correctly identified.

63. HONEY LOCUST, *Gleditschia triacanthos.*

No doubt correctly identified. The Water Locust, *G. aquatica*, ranging from Cape Girardeau County to Pemiscot County in swamps along the Mississippi River, seems not to have been observed by Swallow. The Black Locust, *Robinia Pseudacacia*, seemingly native on the hills and knobs of Newton and McDonald Counties, seems also to have escaped notice by Swallow. The abundant little shrub along all the streams in the Ozark Counties, *Amorpha fruticosa*, also seems to have been neglected by Swallow, and the very conspicuous little Lead Plant, *Amorpha canescens*, abundant in south Missouri in rocky barrens, on prairies, and in dry oak woods, seems to have been overlooked also.

64. WHITE MAPLE, *acer eriocarpum.*

No doubt correctly identified.

65. SUGAR TREE, *Acer nigrum?*

Probably this species, unless it should have been some form of *A. barbatum*, of which several forms occur in many of the Counties in Southern Missouri. From Cape Girardeau County, southward along the bluffs of the Mississippi River, occurs ACER BARBATUM RUGELII (Pax) n. comb. (*A. saccharum Rugelii* (Pax) Rehder). Another form, A. BARBATUM SCHNECKII (Rehder) n. comb. (*A. saccharum Schneckii* Rehder), common in several Counties in Southern Missouri, as well as in Pemiscot County. Still more common in eastern Missouri is ACER BARBATUM GLAUCUM (Sargent) n. comb. (*A. saccharum glaucum Sargent*). I can not see how Swallow could have missed seeing *A. rubrum*, common along streams from Saint Louis County to Greene County, but he does not mention it. Another conspicuous species, *A. Drummondii*, common in swamps, from Cape Girardeau County southward along the Mississippi River, also seems to have escaped the notice of Swallow. On the hills bordering the swamps in Cape Girardeau County is still another tree, *A. rubrum tridens*, not noticed by Swallow.

66. RED MULBERRY, *Morus rubra.*

Probably correctly identified.

67. OSAGE-ORANGE, *Maclura aurantiaca.*
Probably correctly identified.

68. WHITE OAK, *Quercus alba.*
Correctly identified.

69. BUR OAK, *Quercus macrocarpa.*
Correctly identified.

70. POST OAK, *Quercus obtusiloba.*
Correctly identified.

71. SWAMP WHITE OAK, *Quercus bicolor.*
Probable correctly identified, as this species is common in all the Counties in eastern Missouri.

72. CHESTNUT WHITE OAK, *Quercus Prinus.*
It is quite certain that Swallow mistook some other species of oak for this, probably some form of *Q. Muhlenbergii,* as there is no evidence that *Q. Primus* has ever been found in Missouri.

73. ROCK CHESTNUT OAK, *Quercus monticola.*
Obviously the same thing as No. 72.

74. CHESTNUT OAK, *Quercus acuminata.*
Correctly identified and no doubt the same species we now know as *Q. Muhlenbergii.*

75. CHINQUAPIN OAK, *Quercus prinoides.*
I am unable to say what it was that Swallow had in hand when he wrote that, but the name *Chinquapin Oak* more properly belongs to *Q. Muhlenbergii,* which is often found on limestone bluffs.

76. LAUREL OAK, *Quercus imbricaria.*
No doubt the same tree that we know as Shingle Oak, as the name Laurel Oak more properly belongs to *Quercus laurifolia,* a species of the Southeastern States.

77. BLACK JACK OAK, *Quercus nigra.*
Correctly identified.

78. BLACK OAK, *Quercus tinctoria.*
Probably correctly identified.

79. SCARLET OAK, *Quercus coccinea.*
I can scarcely believe that Swallow knew the Scarlet Oak, since many years were spent by trained collectors seeking for it, and it was only a few years ago that it was definitely proven to occur in the State.

80. RED OAK, *Quercus rubra.*
Probably correctly identified.

81. PIN OAK, *Quercus palustris.*
Probably correctly identified.

82. GRAY OAK, *Quercus ambiqua.*
I suspect this is only a form of the Red Oak, but there is nothing to decide this now.

83. SPANISH OAK, *Quercus falcata.*
Swallow states that this species is found in the south-west part of the state, but that is certainly a mistake, as the Spanish Oak occurs only in the southeastern Counties, New Madrid, Dunklin, Butler and Pemiscot Counties. It is likely that Swallow found some form of *Q. velutina* in Southwestern Missouri, which there assumes some very puzzling forms, and the country people call this species Spanish Oak, Slick Oak, Turkey Oak, Shin Oak and other names. It will be noted that Swallow lists sixteen species of oaks for the whole territory covered by the survey, but of these there are certainly four names that are synonyms of other names, or are names of species not known to occur in the State. In Dunklin County, which adjoins Pemiscot County, I once collected sixteen species of oaks in one place, on what is known as the tenth section, a tract of 640 acres. Several species of *Quercus* of interest, seem to have been overlooked by Swallow which seems quite unaccountable. Principal among these are the Cow Oak, *Q. Michauxii, Q. lyrata* and *Q. Shumardii,* all ranging from Cape Girardeau County southward along the Mississippi River in

low swamps. Another conspicuous tree, the Chinquapin, *Castanea ozarkensis,* seems also to have been neglected by Swallow in his Catalogue, but is common in Barry and McDonald Counties. Still another conspicuous tree, the Beech, *Fagus grandifolia,* common on high sandy hills from Cape Girardeau County to Pemiscot and Dunklin Counties, and it seems unaccountable how Swallow could have overlooked it.

84. PAWPAW, *Asimina triloba.*

Correctly determined. The conspicuous tree, the Cucumber Tree, *Magnolia acuminata,* occurs in several of the Counties in Southern Missouri, particularly in Barry County along the bluffs of the White River, but Swallow does not mention it in his Catalogue. Still another large tree, the Yellow Poplar, *Liriodendron Tulipifera,* of conspicuous appearance, occurs on high sandy hills from Cape Girardeau County to Pemiscot County and yet Swallow neglected to include it in his Catalogue.

85. PERSIMMON, *Diospyros virginiana.*

Swallow says this is scarce in Southwest Missouri, but my observations show that it is common on the prairies of that part of the State, often abundant in groves.

86. YELLOW PINE, *Pinus mitis.*

Swallow cites this from Crawford, McDonald and Washington Counties only, but it occurs in all the Ozark Counties in Southern Missouri. A very conspicuous tree, the Bald Cypress, *Taxodium distichum,* seems to have been overlooked by Swallow in his Catalogue, but it is common in swamps from Cape Girardeau County southward along the Mississippi River bottoms.

87. RED PLUM, *Prunus americana.*

I am unable to guess what species Swallow had in hand, but it could scarcely have been *P. americana,* which I have never seen in Southern Missouri.

88. CHICKASAW PLUM, *Prunus Chicasa.*

Probably Swallow had what is now known as *P. Munsoniana,* which is common from Saint Louis County to Newton County, and not the Chickasaw Plum, which is rather uncommon in Southern Missouri.

89. PRICKLY ASH, *Zanthoxylum americanum.*

Swallow lists this species twice. See No. 6.

90. RATAN, *Wistaria frutescens.*

Evidently the species we now know as *W. macrostachys,* which at the time Swallow was writing his catalogue had not been distinguished from *W. frutescens,* but I am not certain by any means that Swallow intended to write *Wistaria frutescens* for the Ratan, as this name belongs to *Berchemia scandens,* a high-climbing, tough vine of Southern Missouri, which Swallow does not mention in this report.

91. PRAIRIE ROSE, *Rosa setigera.*

Correctly identified.

92. SMOOTH ROSE, *Rosa blanda.*

Swallow says this species was observed during the survey, but there can be no doubt that he must have had some other species in hand, probably *R. Bushii,* which occurs in southern Missouri, or *R. heliophila,* which is also common there.

93. SHINING ROSE, *Rosa lucida.*

Swallow says this species also was seen, but I suspect he must have had *R. carolina* in hand at that time, as it is most often mistaken for *R. lucida,* and he does not mention *R. carolina* in his Catalogue. The Swamp Rose, *Rosa palustris,* found from Cape Girardeau County southward along the Mississippi River bottoms in swamps, seems not to have been seen by Swallow.

94. RED RASPBERRY, *Rubus strigosus.*

It is very evident that Swallow mistook some form of the common Black Raspberry for this species, as *R. strigosus*

does not occur in Southern Missouri, or anywhere else in the State so far as I have been able to learn.

95. BLACK RASPBERRY, *Rubus occidentalis.*

Evidently correctly identified and the same as the last species.

96. BUTTONWOOD, *Platanus occidentalis.*

Swallow listed this species twice in the Catalogue. See No. 17.

97. DWARF SUMACH, *Rhus copallina.*

Evidently correctly identified.

98. SMOOTH SUMACH, *Rhus glabra.*

Probably correctly identified.

99. STAGHORN SUMACH, *Rhus typhina.*

Swallow very evidently was mistaken in listing this species, as it is not known to occur in the State, and I suspect that the tree-like forms of *R. copallina* on the prairies of Southwestern Missouri were mistaken for this species.

100. POISON IVY, *Rhus toxicodendron.*

Probably correctly identified.

101. FRAGRANT SUMACH, *Rhus aromatica.*

Evidently some species of the genus that is now sometimes called *Schmaltzia,* but I am unable to say which one it was. The very conspicuous, small tree, *Cotinus americanus,* was overlooked by Swallow, but it is common along the bluffs of Swan Creek, Taney County, a locality where Swallow collected, and one he mentions in several places, as under Witch Hazel, Huckleberry, Blueberry, Honeysuckle and Wild Service Berry.

102. NINE-BARK, *Spiraea opulifolia.*

Probably correctly identified, and what we now know as *S. intermedia,* which has the follicles permanently pubescent.

103. *Spiraea corymbosa.*

I am unable to say what species Swallow had in hand at

that time, as it is pretty certain that *S. corymbosa* does not occur in the State. In some later report Swallow cites this species for Putnam County, but this must have been *S. alba*, which is known to occur in Putnam County.

104. SASSAFRAS, *Laurus Sassafras.*

Swallow says the Sassafras is not common, but in this he certainly erred, as it not only is common in southern Missouri, but often abundant. The Spice-bush, *Lindera Benzoin*, so common along streams in Southern Missouri, seems not to have been seen by Swallow, or else he neglected to include it in his Catalogue.

105. SARSAPARILLA.

I am unable to say just what plant Swallow had in mind when he wrote that, as the name is applied to two very different plants, one the Moonseed, *Menispermum canadense*, a suffrutescent vine with long yellow roots, which is called Parilla or Sarsaparilla, by the country people. The other, *Smilax herbacea*, which is not shrubby at all. In either case the listing of this plant by Swallow is to be regretted, as there are so many more noticeable trees and shrubs that he could have listed, and which he neglected to include in his Catalogue, one of which may be appropriately mentioned here, the Mistletoe, *Phoradendron flavescens*, so common in trees in many of the Counties of Southern Missouri.

106. WILD SERVICE BERRY, *Amelanchier canadensis.*

Probably correctly identified.

107. STAFF-TREE, *Celastrus scandens.*

No doubt but correctly identified, but the name Staff-Tree is not only a misnomer on account the species not being a tree, but the country people call this vine Bittersweet. The Staff-Tree is an European species.

108. BLACK THORN, *Crataegus tomentosa.*

I am unable to say what species of *Crataegus* Swallow had in hand, but it is very unlikely that it was *C. tomentosa*, which is an eastern species.

109. RED HAW, *Crataegus coccinea.*

I am making a guess that Swallow found *C. mollis,* the abundant species throughout Missouri, which he does not mention in this Catalogue, and identified it as *C. coccinea,* but *C. coccinea* is an eastern species.

110. DOTTED THORN, *Crataegus punctata.*

There is no way of telling now what species Swallow had in hand then, but it certainly was not *C. punctata,* which is an eastern species.

111. CRATAEGUS CRUS-GALLI.

It is very improbable that Swallow found the real *C. Crus-galli* at that time, but very likely he had some species of the *Crus-galli* group.

112. CRATAEGUS SPATHULATA.

No doubt wrongly identified, as *C. spathulata* does not occur in any of the Counties in which the survey was made, in such numbers as to likely be found.

113. CRATAEGUS APIIFOLIA.

Swallow undoubtedly made a mistake in identifying this as *C. apiifolia,* as *C. apiifolia* is not known to occur only in the extreme southern part of Dunklin and Ripley Counties, and I suspect that Swallow must have seen *C. cordata,* which occurs in many of the Ozark Counties and mistook it for *C. apiifolia.*

114. TRUMPET CREEPER, *Tecoma radicans.*

Probably correctly identified. The very attractive Crossvine, *Bignonia capreolata,* often found in some of the Counties in Southeastern Missouri, seems not to have been seen by Swallow. The handsome and attractive Catalpa, *Catalpa speciosa,* was also neglected by Swallow in his Catalogue, but he could hardly have overlooked this tree in the field as it is often seen in swamps in many of the Counties in Southeastern Missouri.

115. VIRGINIAN CREEPER, *Ampelopsis quinquefolia.*
Probably correctly determined.

116. BLACK WALNUT, *Juglans nigra.*
Correctly determined.

117. WHITE WALNUT, *Juglans cinerea.*
Correctly determined.

118. SALIX.
Swallow says several species were observed, but he does not cite any species, although several species are abundant along streams.

119. WINTER-BERRY, *Prinos laevigata.*
I am unable to say what it was that Swallow had in hand, as it is pretty certain that it was not *Ilex laevigata,* which is an eastern species.

120. WITCH-HAZEL, *Hamamelis virginiana.*
Cited from Swan Creek, Taney County only, but this species is common to nearly all the Counties in the southern part of the State and is what we now know as *H. vernalis,* a species that flowers in the Spring, having many stems springing from the root, which never make trees, the true Witch-hazel having single stems that assume more or less tree-like forms.

THE STRATIGRAPHY AND LARGER FOSSILS OF THE PLATTIN FORMATION IN STE. GENEVIEVE COUNTY, MISSOURI [1, 2]

By CARROLL LANE FENTON

IV. PALEONTOLOGY

Study of the fossils of the Plattin and Decorah formations of Ste. Genevieve County has extended only to the larger, more typical and more readily identifiable forms. These make up but a small part of the faunas, but the collections represent the lesser types so inadequately that work on them at present is impossible.

Two Plattin species, *Rhynchotrema cuneiforme* and *Zygospira variabilis*, have been described in an earlier paper.[3] Members of the genus *Strophomena*, on the other hand, are left to a later one, in which species from the Decorah of Minnesota and two from the Richmond of the Ohio valley will be introduced for comparison.

Finally, I must repeat a caution already stated: that in statements of occurrence the qualifications middle, lower and upper refer only to the Plattin strata of Ste. Genevieve County, not to the formation as a whole.

BUTHOTREPHIS REGULARIS N. SP.

PLATE I, FIG. 1.

Description.—Stems cylindric or subcylindric, 7 to 8 mm. in diameter, and tapering gradually. Each of the three stems

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1 Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 3.

2 Continued from page 96, Vol. XI, No. 2.

3 C. L. Fenton and M. A. Fenton, Proc. Ia. Acad. Sci., vol. 29, pp. 67-84. 1923. (Not 1922, as printed on title page of the volume.)

in the holotype bears evenly spaced branches whose diameter is about half that of the main stem. Each branch is constricted at its origin. Surface apparently smooth.

Remarks.—This form is distinguished by its regularly spaced branches, and by their constriction.

Occurrence.—Number 14 of the Plattin, near the north end of South Beckett Hill.

BUTHOTREPHIS BRACHIATUS N. SP.

PLATE I, FIGS. 2-3.

Description.—Stems cylindric or subcylindric, repeatedly bifurcating, with blunt terminations. Diameter of stems 4.5 to 7.5 mm.; maximum length between bifurcations, among the specimens at hand, 61.6 mm.

Remarks.—This form is with some doubt referred to the genus *Buthotrephis*. The habit of bifurcate branching is its most distinctive character.

Occurrence.—Number 24 of the Plattin of South Beckett Hill; probably in higher beds as well.

BUTHOTREPHIS SP.

PLATE I, FIG. 4.

From Number 14 of the Plattin, near the north end of South Beckett Hill, comes a specimen of *Buthotrephis* whose characters are shown in the figure. The surface appears to be marked by shallow pits, though the appearance may be merely a result of weathering. Fucoidal casts of a type similar to this are common throughout the basal fifteen members of the Plattin.

PALEOPHYCUS TUBULARE HALL

PLATE I, FIG. 5.

Paleophycus tubularis Hall, Pal. N. Y., vol. 1, p. 7, pl. 2, figs. 1-2, 4-5. 1847.

Description.—Stems terete, infrequently branched, subcylindric; surface nearly smooth. In the specimen figured, the stem is slightly flexuous, while its tapering character is not distinguishable. The diameter ranges from 15 to 18 mm.

Remarks.—This cast closely resembles the one shown by Hall in Fig. 1 of the reference given. Identification must be uncertain, of course, but the similarities of the specimens from New York and Missouri seem great enough to warrant use of Hall's name for the latter.

Occurrence.—Number 15 of the Plattin, near the north end of South Beckett Hill.

DYSTACTOSPONGIA MINOR ULRICH AND EVERETT

NOT FIGURED.

Dystactospongia minor Ulrich and Everett, Geol. Surv. Ill., vol. 8, page 278, pl. 8, figs. 3 a-b. 1890.

Dystactospongia minor Hayes and Ulrich, U. S. Geol. Surv., Folio 95, illust. sheet, figs. 48-49. 1893.

Description.—Sponge massive, lobate or subconical; composed of tubes which radiate from the base to the upper surface, where they show diameters ranging from .5 to .9 mm. The average thickness of the tube-walls is about .2 mm., though Ulrich and Everett mention walls .4 mm. thick. At the surface several tubes commonly coalesce.

In vertical section the tube-walls are seen to thicken toward the base, and are pierced by large, irregular openings. Some of them have been traced for 27.5 mm. without showing appreciable change in diameter. In the holotype the canal cavities are traversed by branching or simple fibers of calcite which probably represent spicules. No trace of these has been found in the silicified specimens from Missouri.

Remarks.—The tubes of specimens from Ste. Genevieve County are larger and somewhat more distinct than those of the holotype but are essentially like those of the specimens illustrated by Hayes and Ulrich.

Occurrence.—Platteville of Dixon, Ill.; Carters limestone

of the Columbia Quadrangle, Tenn.; Plattin of St. Genevieve Co., where it is abundant in numbers 32 to 35, and common in other strata from 22 to 38.

STREPTELASMA CORNICULUM MEDIUM N. VAR.

PLATE II, FIGS. 5-7.

Description.—Corallum much like that of *S. corniculum* Hall, but smaller and less curved. The largest specimen observed has a diameter of 23 mm. and a height of 29.17 mm.

The calyx is intermediate in depth between those of *S. corniculum* and *S. profundum*. Septa alternating; 30 to 36 of each series in medium or large specimens; as few as 24 in small ones. They commonly are twisted at the center, and in a few specimens form weak pseudocolumellae. Specimens from the operculum bed are larger, and have slightly shallower calyces than do those from other horizons.

Remarks.—It seems probable that the specimens figured by Winchell and Schuchert (Geol. Minn., vol 3, pt. 1, pl. G., figs. 20-21) belong to this variety, which perhaps might properly be called a race of *S. corniculum*.

Occurrence.—Platteville, Mineral Point, Wis., and probably other localities; Plattin of Ste. Genevieve County, Mo. Here it is generally distributed above Number 20 of the section, and is abundant in number 32.

COLUMNARIA HALLI NICHOLSON

PLATE II, FIGS. 1-2.

Columnaria (?) *halli* Nicholson, Tabulate Corals Pal. Per., p. 200, fig. 29; pl. 10, figs. 3-3a. 1879.

Columnaria (?) *halli* Winchell and Schuchert, Geol. Minn., vol. 3, p. 85, pl. G, figs. 14-16. 1893.

Description.—Corallum massive, flattened or depressed hemispherical. Corallites generally irregularly hexagonal, and highly variable in size; their maximum diameters range from 1.5 to nearly 6 mm. Septa short, heavy, continuous. Tabulae

strong, horizontal and complete, numbering 8 or 9 in the space of 10 mm.

Remarks.—The Missouri specimens of *C. halli* form smaller masses than those from New York, but larger than those from the Platteville of Minnesota. The septa are shorter than in High Bridge specimens identified as *C. halli*, but no other significant differences appear.

Occurrence.—In the Plattin of Ste. Genevieve County, *C. halli* ranges from the lower members to the top of the formation, but is most abundant in Number 24 of the general section.

MONOTRYPA MAGNA ULRICH

PLATE II, FIGS. 3-4.

Monotrypa magna Ulrich, Geol. Minn., vol. 3, pt. 1, p. 304, pl. 27, figs. 28-29. 1893.

Description.—Zoarium typically subhemispherical, but in some cases massive with sharp processes; 10 to 150 mm. in diameter. Zooecia polygonal, 0.4 to 0.8 mm. in diameter, the average being about 0.5 or 0.6 mm. Walls thin to thick, smooth to crenulate in vertical sections. Diaphragms 0.2 to 8 mm. apart, but rarely more than 3 mm.; in many specimens they lie rather uniformly along discernible levels, and even give a false appearance of laminae. This character commonly is most marked in regular, subhemispherical masses.

Remarks.—Ulrich lists as additional characters, a clustering of the larger zooecia and (generally) the presence of a wrinkled epitheca. Neither of these features appear in specimens from Ste. Genevieve County, where zooecial walls are heavier and less undulating, and whose zooecia seem to be larger than those which Ulrich figures. They also show more regular arrangement of the diaphragms.

This last character makes the species suggest a very small-celled member of the genus *Dania* of Milne-Edwards and Haime. The original figure of the latter, however, seems to be highly diagrammatic, and the resemblance may be less sub-

stantial than it seems. Yet it serves to emphasize the uncertainty of the boundary separating the tabulate "corals" from the Bryozoa.

Occurrence.—Platteville formation at Dixon, Ill., and Mineral Point and Beloit, Wisconsin; Plattin at House Springs, Mo., and in Ste. Genevieve County, where it is especially common in Number 32 of the general section.

RAFINESQUINA MINNESOTENSIS (N. H. WINCHELL)

PLATE II, FIG. 8.

Strophomena minnesotensis Winchell, 9th Ann. Rep. Geol. Nat. Hist. Surv. Minn., p. 120. 1881.

Rafinesquina minnesotensis Winchell and Schuchert, Geol. Minn., vol. 3, pt. 1, p. 401, pl. 31, figs. 25-29. 1893.

(For additional bibliography see Bassler, Bull. 92, U. S. Nat. Mus.)

Description.—Shell of medium size. Dimensions of two brachial valves and one pedicle: length 22.5, 21.5 and 20.3 mm.; width 26.5, 26 and 25.5 mm. Convexity of two brachial valves, about 5 and 6 mm., the former being the specimen of which other measurements have been given.

Pedicle valve moderately convex in the umbonal region, increasingly so medially, and somewhat flattened posterolaterally. Cardinal area 1 to 2 mm. in height, slightly concave; beak protruding but not recurved. Cardinolateral extremities generally slightly produced in mature specimens, though not in young. Diductor scars large, together forming nearly a circular area; their margins are but slightly elevated. Adductor scars located on a low rounded ridge which in some specimens is produced into a median septum. A low ridge runs from 3 to 4.5 mm. within the lateral margins, turning centrally and fusing with the posterior margin, whose internal characters are not preserved in the molds available for study.

Brachial valve slightly concave, flattened over most of its surface, and reflected near the margin. Within the margin is a shallow linear impression; between this and the margin

is a heavy ridge crossed by vascular channels. In the center of the valve are smooth, abrupt, digitately radiating ridges, the middle one of which extends to the depression within the margin, or disappears upon the visceral disc. The others rise and enlarge abruptly, terminating anteriorly in abrupt enlargements; none of them reach the umbonal region. Hinge plates short and widely divergent; behind them are small, double-grooved sockets. The beak, according to Winchell and Schuchert, is perforate.

Remarks.—This form appears to be derived from *R. incrassata* (Hall), found in Chazyan of New York and eastern Tennessee. From Sardeson's variety *inquassa* the typical *R. minnesotensis* differs in its lesser convexity and greater proportion of length to width.

Among the Missouri specimens there is some variation, apparently in accordance with age. The smaller specimens are subquadrate in outline and lack the strong median ridge which characterizes the brachial valve of the larger individuals, and the border ridge is but slightly developed. With increasing size, however, these differences disappear.

Occurrence.—Decorah ("Trenton Shales") of St. Paul, Cannon Falls and Fountain, Minnesota, and Decorah, Iowa; Platteville of St. Paul, Minnesota, Janesville and Beloit, Wisconsin, and Rockton and Dixon, Illinois; Black River of Kentucky and Tennessee. In Ste. Genevieve County, Missouri, *R. minnesotensis* is found in the middle Plattin (No. 15) and extends nearly to the top of the formation. It seems to be dominantly a Platteville-Plattin form, and indentifications of it from the Decorah are open to question.

DINORTHIS DEFLECTA GIBBOSA N. VAR.

PLATE V, FIGS. 2-9.

Description.—Shell of medium size: length .70 to .85 of the width; extremities commonly rounded. Dimensions of a pedicle and two brachial valves: length 20, 17.4 and 17 mm.; width 27.7, 23 and 20.1 mm.

Pedicle valve convex umbonally, concave medially. Umbonal fold replaced anteriorly by a poorly defined sinusal depression which fails to appear in young shells. In older ones growth lamellae are fairly common, often forming a strong external intramarginal ridge. Cardinal extremities sharply convex. Brachial valve convex umbonally and less so anteriorly, with recurved extremities. Mesial depression marked umbonally, but faint in the anterior region. Growth lamellae appear 12 to 14 mm. anterior to the beak; they are massed, and commonly heavy. Internal characters shown by the figures.

Remarks.—Only those characters have been mentioned which serve to distinguish the form *gibbosa* from the typical *D. deflecta* as figured by Hall, Hall and Clark and Winchell and Schuchert. The greater length and convexity and persistently rounded extremities, even in young shells, are diagnostic characters.

From the fact that Winchell and Schuchert mention shells whose hinge lines are "two-thirds, or as long as, the greatest transverse diameter of the shell," it may be assumed that the form *gibbosa* occurs in other regions than Ste. Genevieve County. However, its prevalence there probably entitles it to rank as a geographic race. Without a much larger series of specimens than is available, however, the point cannot be determined.

Occurrence.—Plattin of Ste. Genevieve Co., Mo., particularly in the operculum bed (number 37) on South Beckett Hill. Probably in other Black River strata of the Mississippi Valley.

PIANODEMA SUBAEQUATA (CONRAD)

PLATE III, FIGS. 13-15.

Orthis subaequata Conrad, Proc. Acad. Nat. Sci. Phila., vol. 1, p. 333. 1843.

Dalmanella subaequata Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pp. 194, 207, 224, pl. 5 C, Figs. 6-11. 1892.

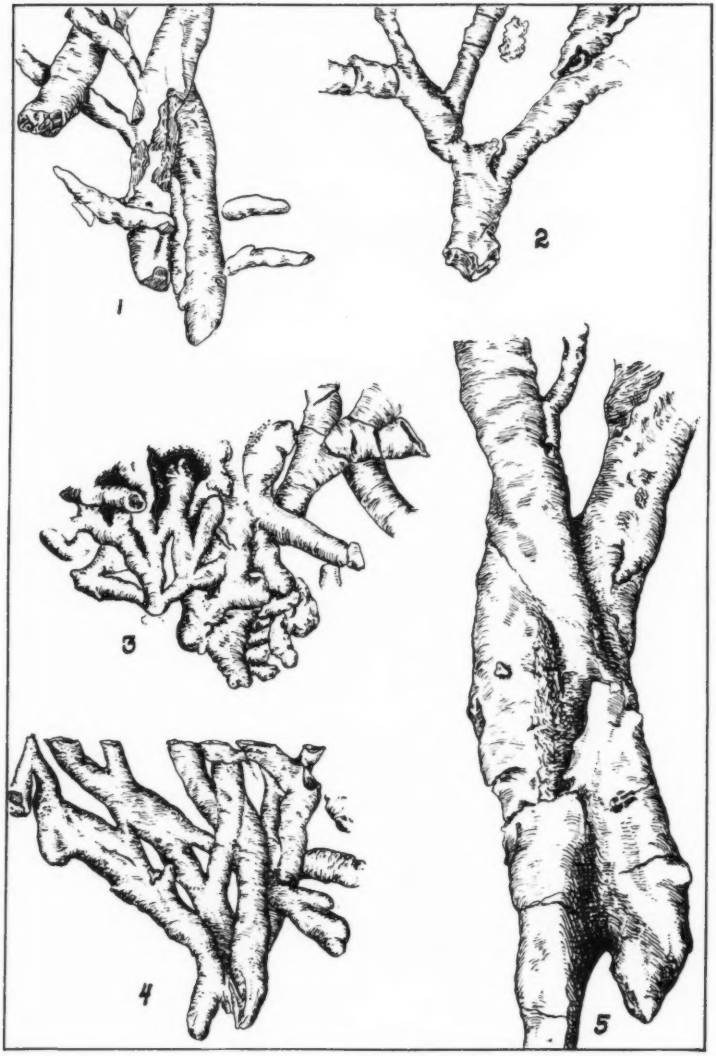
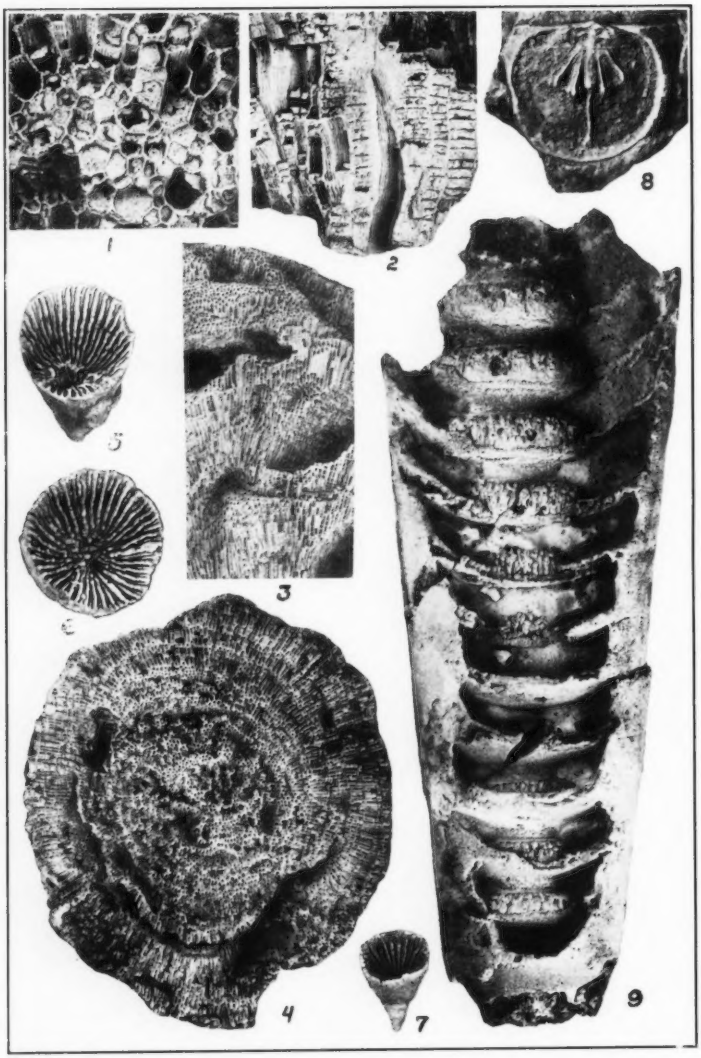


Plate I



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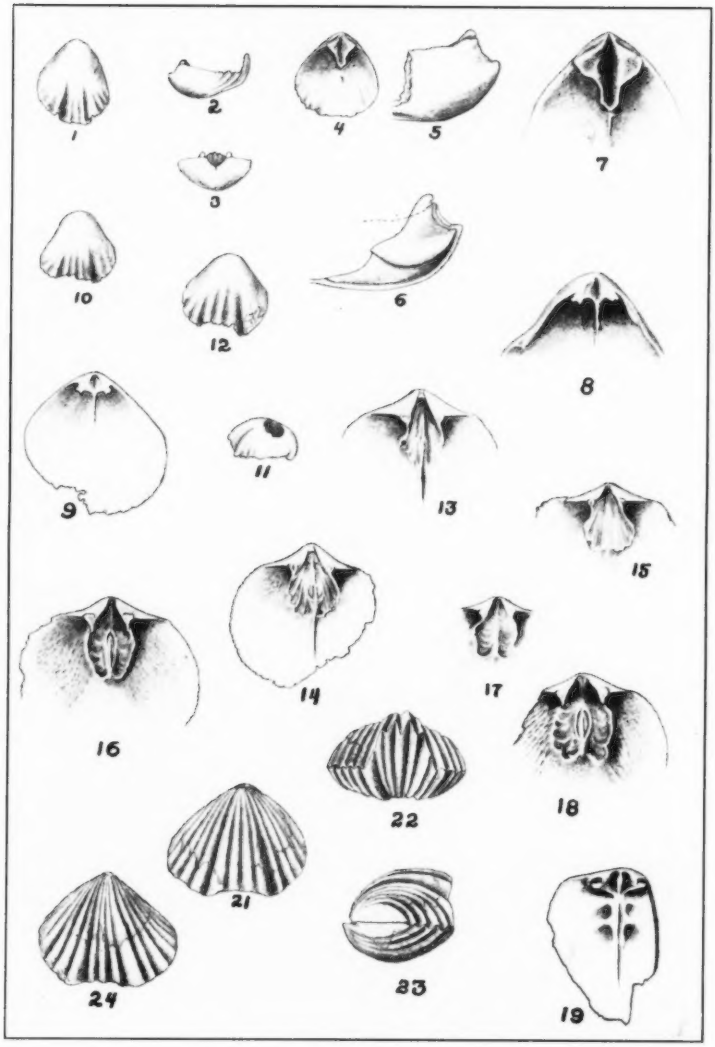

Plate III

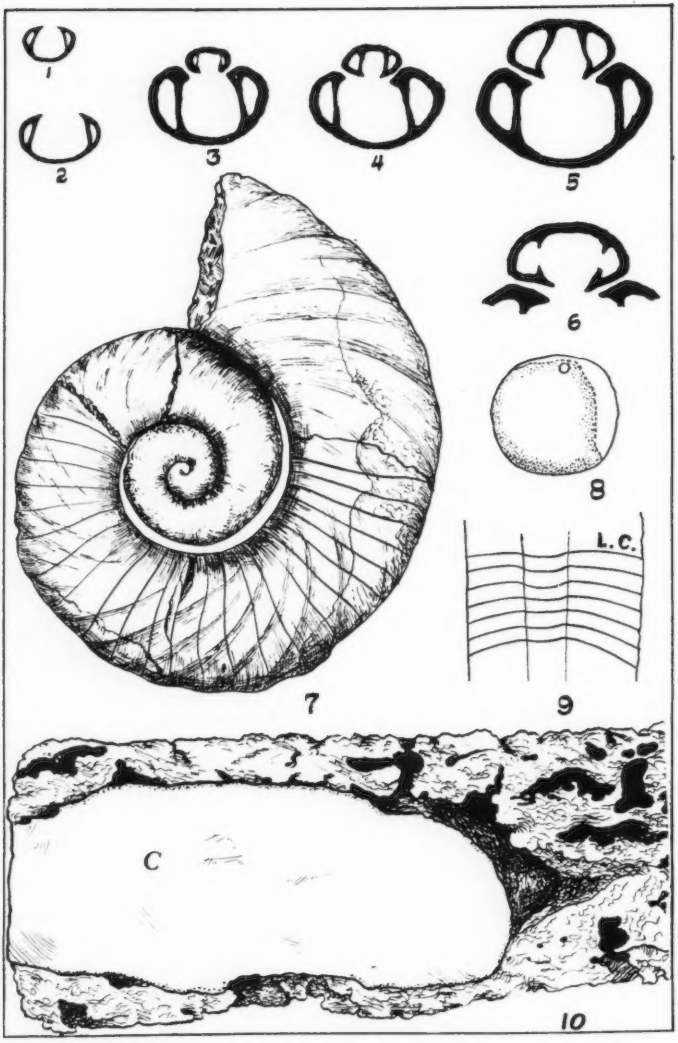

Plate IV

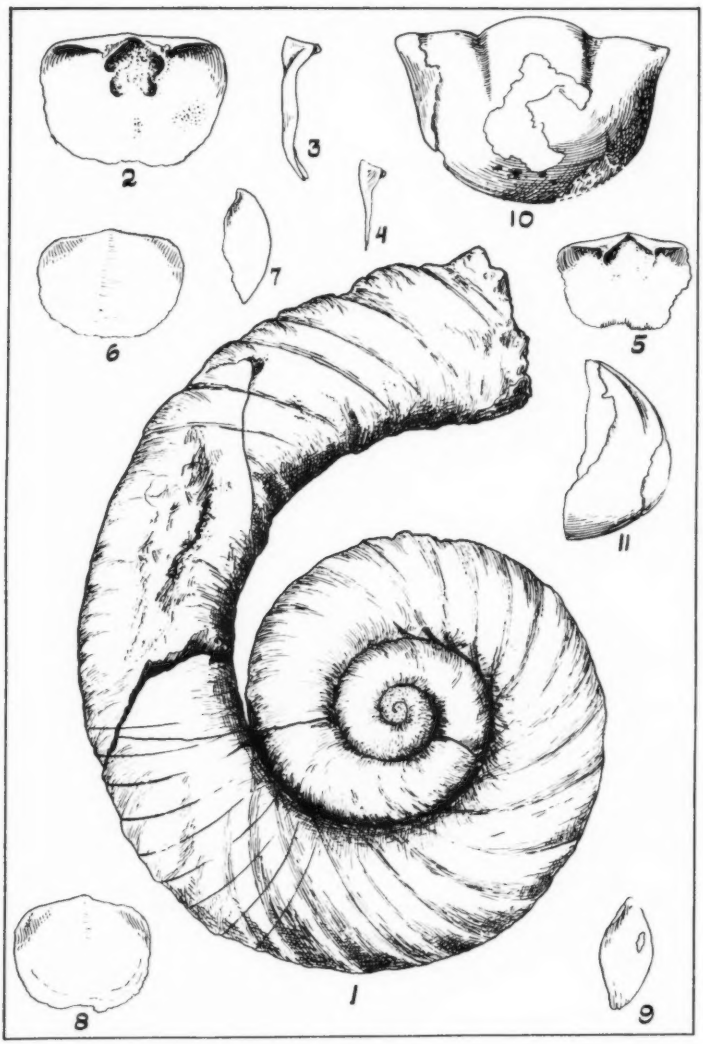

Plate V

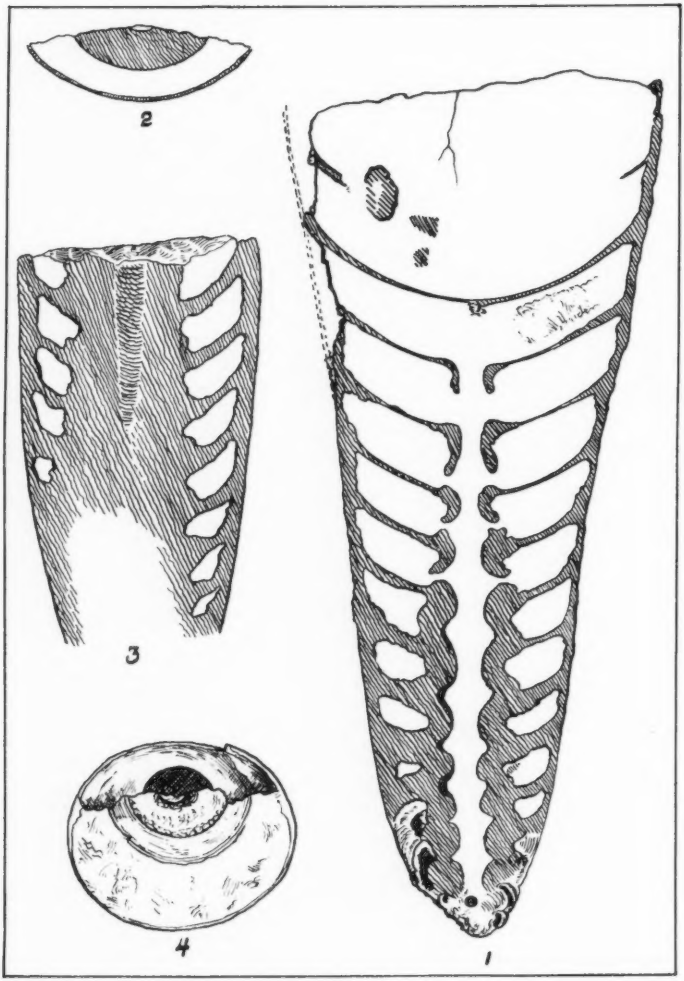

Plate VI

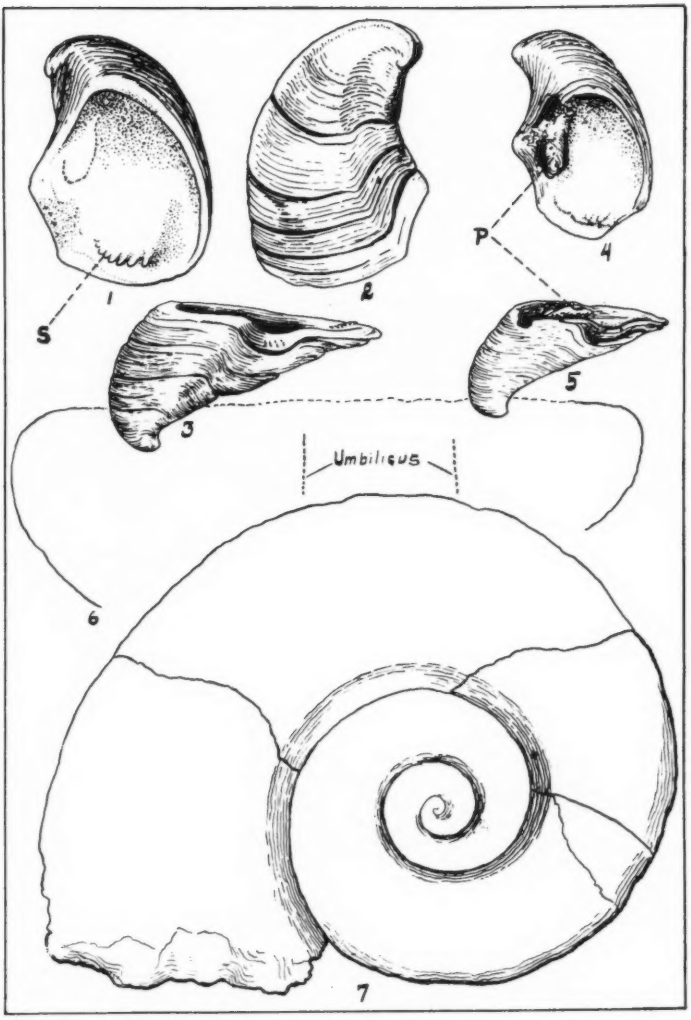

Plate VII

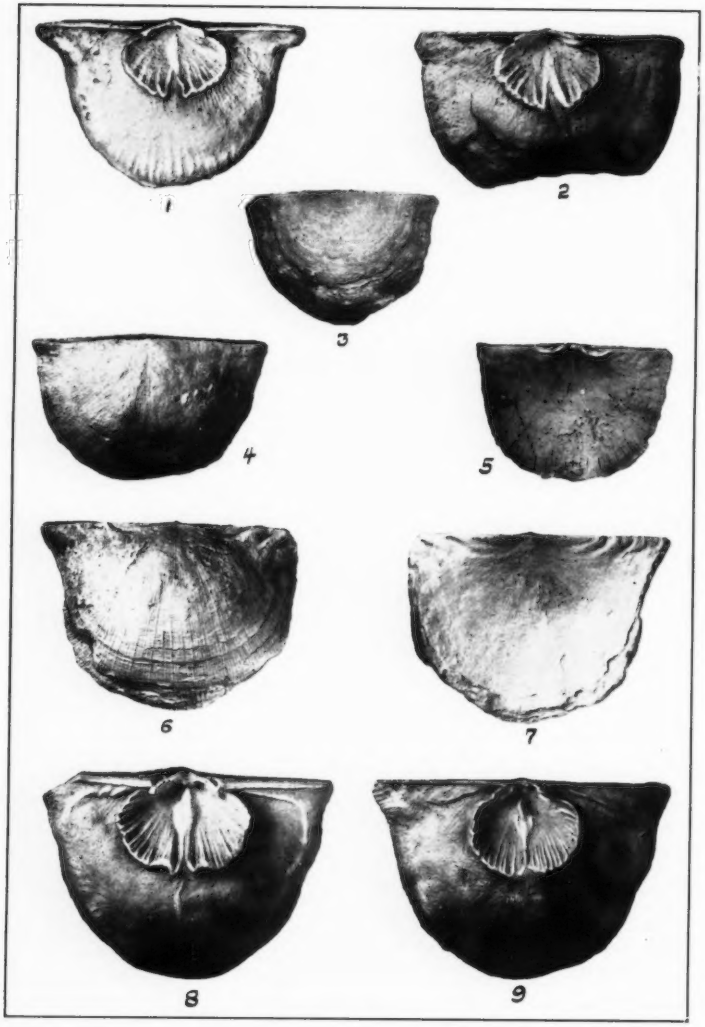

Plate VIII

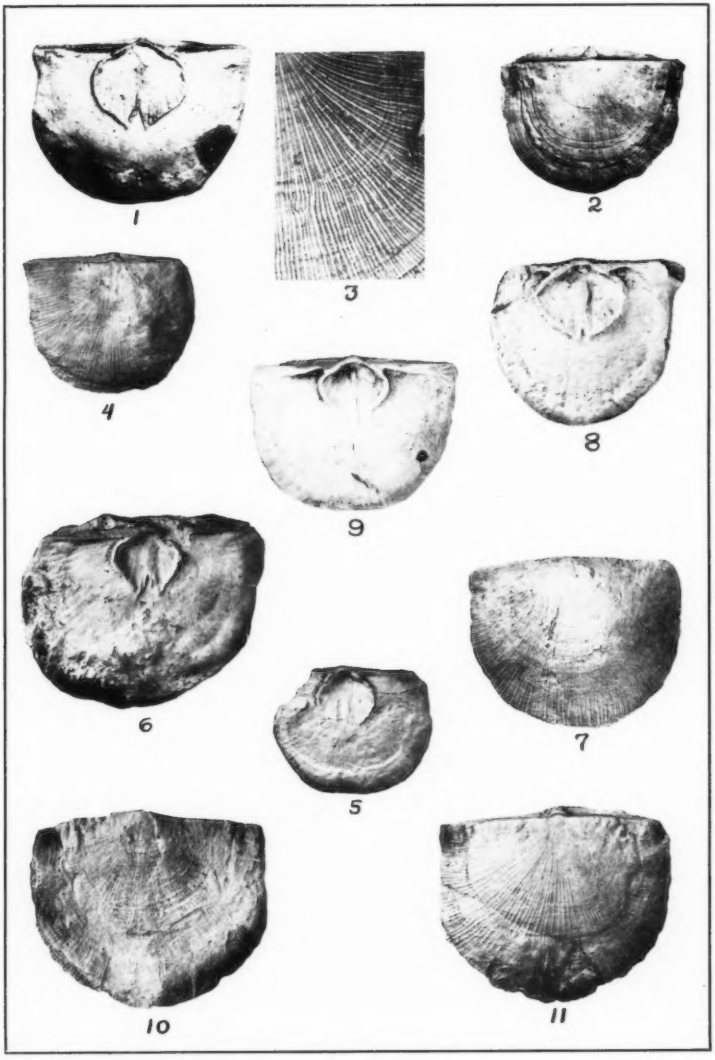

Plate IX

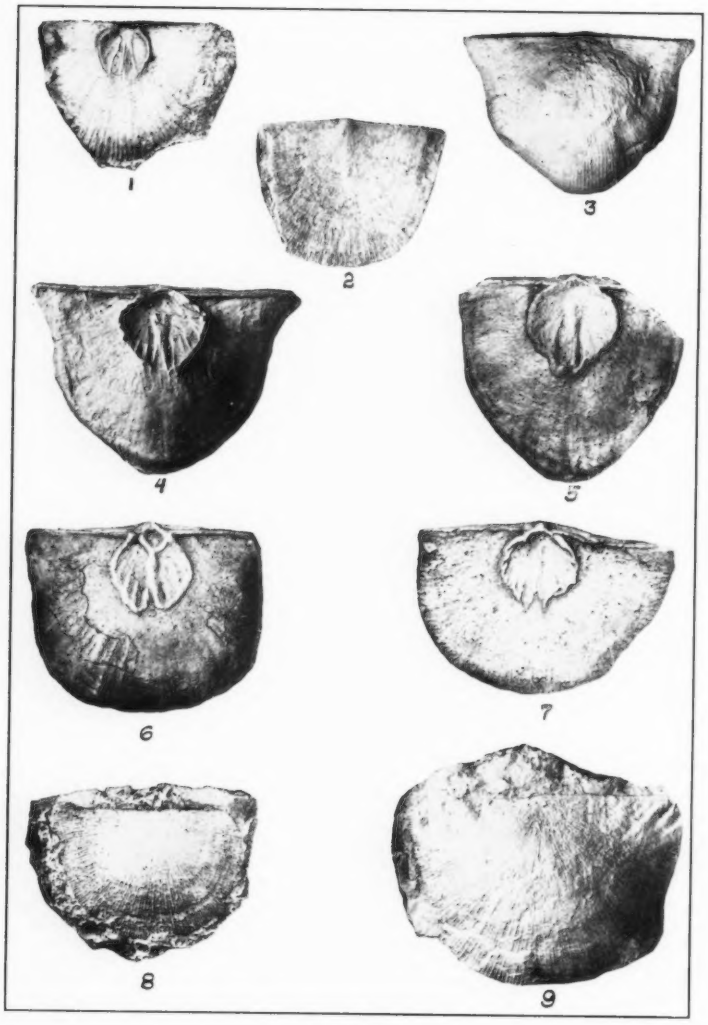

Plate X

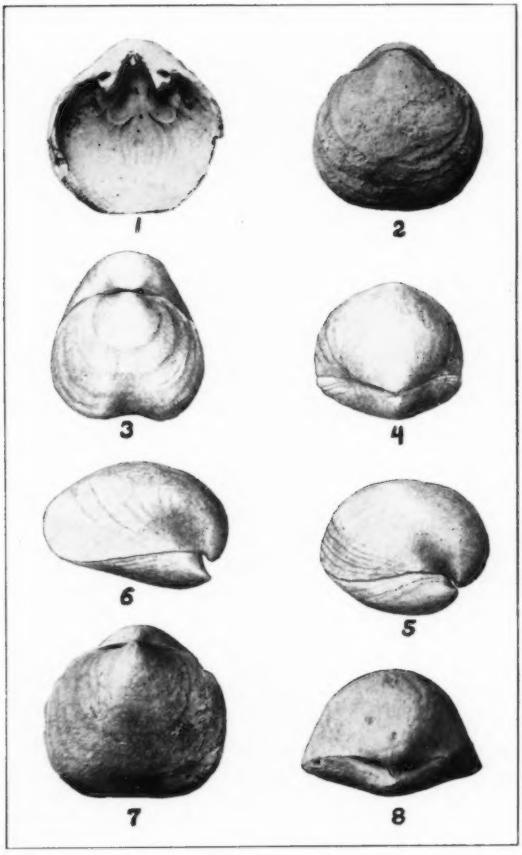

Plate XI

Orthis (*Dalmanella*) *subaequata* Winchell and Schuchert, Geol. Minn. vol. 3, pt. 1, p. 446, pl. 33, figs. 30-36. 1893.

(For other references see Bassler, Bull. 92, U. S. Nat. Mus.)

Description.—Since the species has been described in some detail by Winchell and Schuchert, only those of its characters will be mentioned which serve to distinguish it from *P. perveta.*

Pedicle valve rather uniformly convex; flattened rather than sharply depressed posterolaterally. In most specimens the sinus is indistinguishable within 10 mm. of the beak, and is neither deep nor sharply defined. Internally, the diductor scars are bounded by a sharp, highly crenulate margin which, in this shell, is lacking from the anterior part of the scar. Scars radiately ridged and furrowed; so far as can be told there are no concentric wrinkles. Adductor scars faintly impressed on the slopes of a sharply angular septum which reaches its greatest size within the limits of the diductor scars, but continues anteriorly for 2 to 4 mm., even on thin shells.

Brachial valve uniformly convex, or with a gentle fold; mesial depression rare. Even when present it rarely reaches the middle of the valve. Septum and muscle scars less marked than in *P. perveta.*

Surface of both valves marked by radiating costae which, in the anteromesial region number 14 to 17 in the space of 5 mm. They are rounded, and separated, by fine, angular furrows. Though tubular in the mesial regions, they show few openings, and I have seen no specimens in which they are even incipiently spinose.

Occurrence.—Black River, Mississippi Valley. Lower Plattin, "Widow's Nose," and perhaps higher strata on South Beckett Hill, Ste. Genevieve Co., Mo.

PIANODEMA PERVETA (CONRAD)

PLATE III, FIGS. 16-19.

Orthis perveta Conrad, Proc. Acad. Nat. Sci. Phila., vol. 1, p. 333. 1843.

Orthis perveta Hall, Geol. Wis., vol. 1, p. 42, fig. 7. 1862.

Orthis (*Dalmanella*) *perveta* Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pl. 5 C, fig. 12; perhaps 13-14. 1892.

Orthis (*Dalmanella*) *subaequata* var. *perveta* Winchell and Schuchert, Geol. Minn., vol. 3, pt. 1, p. 450; pl. 33, figs. 41-42. 1893.

Orthis (*Dalmanella*) *subaequata* var. *gibbosa* Winchell and Schuchert, Geol. Minn. vol. 3, pt. 1, p. 451 (part) pl. 33, figs. 43-45. 1893.

(For other references see Bassler, Bull. 92, U. S. Nat. Mus.)

Description.—Shell small, with greatest width anterior to hinge line; extremities angular or rounded. Dimensions of three specimens from the Decorah shale, the third gerontic: length of brachial valve 13.5, 16.7 and 16.5 mm.; length of pedicle valve 15.6, 17.5 and 17 mm.; width 19, 22.3 and 19.7 mm.; thickness 9.8, 14 and 14 mm.; height of cardinal area 3.2, 3.3 and 5 mm.

Pedicle valve convex umbonally, becoming flattened near the extremities; 5 to 6 mm. anterior to the beak appears a shallow, broad sinus, whose boundaries are marked by sharp depressions, but whose central portion is convex. Extremities typically angular but rounded in gerontic specimens. Cardinal area arched; deltidium rudimentary. Teeth heavy, supported by short, heavy dental plates. Internally the diductor scars are deeply impressed and bounded by a heavy angular margin which normally continues unbroken around the anterior margin of the scar. Radiating ridges and depressions, such as characterize *P. subaequata,* are faint or absent; their place is taken by concentric wrinkles which are strong in thick shells. Adductor scars are sharply impressed on either side of a broad median ridge which rarely extends beyond the muscular region. Genital ridges and pustules heavy.

Brachial valve convex umbonally, recurved on the extremities with a broad mesial depression which in some old specimens is replaced anteriorly by a low, broad fold. Internally, the diductor scars are situated on a sharp septum, while the

four adductor scars are shallow. Cardinal process and crural plates heavy.

Surface of both valves marked by rounded costae which increase by bifurcation and are separated by angular furrows. In the mesial region, particularly of the pedicle valve, these costae are tubulose and even subspinose. In this region they number 9 to 12 in the space of 5 mm.

Remarks.—Heretofore the diagnostic character of this form has been only its coarse costae. Specimens from the Plattin, however, show marked and constant internal difference from *P. subaequata*, which certainly entitle *perveta* to rank as a species.

Its relationships to *P. gibbosa* of the East I have not been able to determine. From the coarseness of its plications, however, it seems clear that the specimen of Winchell and Schuchert's figures is a gerontic individual of *P. perveta*.

Occurrence.—Plattin (lower?) "Widow's Nose," numbers 27 (and higher beds) South Beckett Hill, Ste. Genevieve Co., Mo.; Decorah, near Ste. Genevieve, Mo.; Decorah (?) Minneapolis, Minn.

PROTORHYNCHA? PLATTINENSIS N. SP.

PLATE III, FIGS. 21-24; PLATE IV, FIGS. 1-6.

Description.—Shell small; dimensions of three specimens (the holotype and two paratypes): length 8.8, 7.9 and 7.2 mm.; width 10.4, 10 and 7.6 mm.; thickness 6.8, 6.2 and 4.3 mm.; width of sinus 5.8, 4.6 and 4.7 mm.

Pedicle valve moderately convex umbonally, but flattened on the lateral slopes, which meet the antero-lateral margin with but slight increase in convexity. Beak prominent, sharp, incurved, with the delthyrium partly filled by the beak of the brachial valve. Mesial sinus originates 2 to 3 mm. anterior to the beak; it contains 3 to 5 plications which are either simple or, in rare cases, bifurcating. Brachial valve more convex than the pedicle; beak abruptly incurved, lateral slopes strongly convex. Umbonally there is a distinct depression,

which gives way to the fold about 3 mm. anterior to the beak. Plications of the fold generally number 4, rarely bifurcating. Surface of the valve marked by 17 to 19 strong plications.

Remarks.—This shell is referred to *Protorhyncha* with considerable doubt. It differs from the description given by Hall and Clark in having a pronounced sinus, and from *P. ridleyana* as determined by Ulrich, in having marked septal plates.

The whole status of the genus,, moreover, is uncertain. Raymond[4] and Bassler[5] show that the species which Hall and Clarke illustrated in their descriptions of *Protorhyncha* actually belongs to another genus; that the genotype probably is *P. ridleyana* of Safford, and that the only member of the genus which has been properly described is the *Catazyga uphami australis* of Foerste.[6] Even for this no illustrations of internal characters are given. In view of this general uncertainty it might be well to discard the genus—but that would require more study than has been possible in the preparation of this paper. The one remaining course has been to refer this plattin shell to *Protorhyncha*, with this expression of uncertainty.

Occurrence.—Plattin, particularly Numbers 2 and 3 of the general section in the Little Saline region. Apparently equivalent beds near Glencoe, Missouri.

CAMARELLA BELLA N. SP.

PLATE III, FIGS. 1-12.

Description.—Shell small, gibbous. Dimensions of two pedicle valves and a brachial: length 12, 12.5 and 10.6 mm.; width 11.2, 12.6 and 11.3 mm., thickness 4.7, 4.6 and 6.5 mm. These specimens are shown on figs. 1-3, 4 and 10 respectively.

Pedicle valve convex umbonally, depressed laterally, with a broad, flat-bottomed sinus anteriorly. Cardinal slopes abrupt,

4 Ann. Carn. Mus., vol. 7, p. 226. 1911.

5 Bull. 92, U. S. Nat. Mus., p. 1049. 1915.

6 Bull. Sci. Lab. Den. Univ., vol. 16, p. 31, pl. 2, figs. 19 a-b; pl. 3, figs. 14 a-c. 1910.

flattened. On the sinus are 3 or 4 rounded plications separated by deep, angular furrows; on the slopes these number 4 or 5, the outermost always being faint and incomplete. Internally the dental lamellae unite to form a deep, elongate spondylium, which is borne upon a thin septum.

Brachial valve, in adult shells, more convex than the pedicle, with low, flattened fold. Internally the heavy, angular crural bases are borne on short plates which are continuous with a long, low septum. Plications correspond to those of the opposite valve.

Remarks.—Externally the wider specimens of *C. bella* resemble some of the specimens of *C. volborthi* Billings. In that form, however, the plications are stronger than in the Missouri species, the crural plates shorter, and the crural bases rounded rather than angularly sub-bifid at their termini.

Occurrence.—Lower middle beds of the Plattin, Ste. Genevieve Co., Mo. Collected by Dr. Stuart Weller.

MACLURITES BIGSBYI HALL

Remarks.—Shells of *M. bigsbyi* are uncommon in the Plattin of Ste. Genevieve County. One, 40 mm. in diameter, was collected in the operculum bed (Number 27), in a slab containing the form *dixonensis*. Two smaller specimens were collected from Number 26.

MACLURITES BIGSBYI DIXONENSIS ULRICH

PLATE VII, FIGS. 1-7.

Maclurea bigsbyi dixonensis Ulrich, Geol. Minn., vol. 3, pt. 2, p. 1039. 1897.

Description.—Shell large, ranging to 95 mm. in diameter. General shape like that of *M. bigsbyi*. Outer margins rounded, fitting within an angle of slightly less than 90 degrees. The umbilicus takes up less than one-third the diameter of the shell—in the holotype its diameter is 22 mm.; the walls are so steep as to be nearly vertical. Characters of the operculum are shown in the figures.

Remarks.—None of the specimens referred to *M. bigsbyi dixonensis* are well preserved, but the casts show the characters of outer angle, small umbilicus, and steep wall which characterize that form. The outlines of the opercula conform to *dixonensis* rather than *bigsbyi*, and some of them are much too large to fit any of the latter shells which have been found in the Plattin.

Two or three specimens suggest Whitfield's species, *Maclurina subrotunda*, but they are not adequate for identification. By far the greatest number of Plattin specimens belong to the former type, which from its apparently scanty development in the Platteville, seems to be the southerly race of the species *bigsbyi*.

Occurrence.—Platteville, Mineral Point, Wis., and Dixon, Ill.; one specimen is available from each locality. Common in the middle and upper Plattin of Ste. Genevieve County; abundant in beds number 26 and 27 of the general section.

ACTINOCERAS GRAVICENTRUM N. SP.

PLATE II, FIG. 9; PLATE VI, FIGS. 1-4.

Actinoceras bigsbyi Clarke, Geol. Minn., vol. 3, pt. 2, p. 781, pl. 47, figs. 16-17. 1897. (Fig. 15 may represent a variety.)

Description.—Large orthoceracone, the largest specimen at hand having the following dimensions: length (incomplete), 168 mm.; minimum transverse diameter, 28 mm.; maximum 71 mm.; a paratype has a minimum transverse diameter of 24 mm., with the end of the shell not shown.

Septa strongly concave, thin near the living chamber, but thickened by secondary deposits posteriorly. Camerae from 8 to 14 mm. in length, increasing in size toward the living chamber. In the apical region they are largely filled by expansions of the siphuncular wall. This is large and heavy, constricted at the septa, and expanding and thickening strongly between them. The great thickness of the wall in the apical region makes the siphuncle appear to diminish in size anteriorly. It is markedly eccentric.

Remarks.—This, the most characteristic cephalopod of the Plattin in Ste. Genevieve County, seems to be identical with specimens from Minnesota identified as *A. bigsbyi* by Clarke. That species was figured, without name, by Bigsby in the Transactions of the Geological Society of London (2d. ser., vol. 1, pl. 25, figs. 1-2) and later named by Bronn; no description, based on the types, is available. Moreover, the figures show shells which have more moderate rates of expansion than does *A. gravicentrum*, and smaller camerae; that is, shells close to *A. tenuifilum* Hall from the Black River of New York. To that species *A. gravicentrum* also is closely related, and perhaps a large series of specimens from many localities would show it to be but a variety of the New York species. Until such a series is available it seems well to adopt the convenient, though perhaps artificial, device of calling *A. gravicentrum* a species.

Occurrence.—Platteville of Minneapolis and Rochester, Minn.; middle Plattin of Ste. Genevieve County, Mo., where numbers 25 and 26 of the general section bear abundant broken conchs of the species.

EURYSTOMITES ROBERTSONI (HALL)

PLATE IV, FIGS. 7-9; PLATE V, FIG. 1.

Lituites robertsoni Hall, Geol. Surv. Wis., Rep. Prog., p. 38. 1861.

Lituites robertsoni Whitfield, Mem. Am. Mus. Nat. Hist., vol. 1, pt. 2, p. 64, pl. 10, figs. 4-6. 1895.

Eurystomites robertsoni Miller, N. A. Geol. Pal., 2d. App. p. 773. 1897.

Description.—Conch discoid, loosely nautiliconid, moderately depressed, the venter being slightly flattened and the lateral zones but moderately curved. Whorls three or four. Siphuncle circular in section, slightly nummuloidal, subventran. Senile whirl free. Character of aperture unknown. Apertural diameter of larger plesiotype about 26 mm.; diameter at base of living chamber 22 mm. Length of living

chamber, measured along venter, 117 mm. Rate of expansion in the smaller plesiotype somewhat less than is indicated by these measurements of the larger.

Septa moderately concave. Sutures straight in nepionic stages; in the ephebic they develop dorsal saddles with low auxiliary lobes. In the outer whorl the camerae average 5 mm. in maximum depth.

Surface marked by undulating folds which arise on the upper lateral zones and curve backward and downward, extending as low, indistinct ridges onto the venter. In some specimens (large cotype; larger plesiotype), the ridges from opposite sides meet on the venter; in others (small plesiotype), the center of the venter is smooth in ephebic stages.

Remarks.—Hall's cotypes, preserved in the American Museum of Natural History, correspond closely to the smaller of the two specimens from Ste. Genevieve County. None of these possess more than a fraction of the living chamber, whose cast is almost entire in the larger Missouri specimen. Apparent differences in rate of expansion may be caused by weathering.

Occurrence.—"Buff limestone" of the Platteville at Beloit, Wis., and Rockford, Ill.; upper Plattin, Gabouri Creek, and number 26 of the Plattin at South Beckett Hill, Ste. Genevieve County, Mo.

EXPLANATION OF PLATES

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PLATE II

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PLATE III

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16—19 *Pianodema perveta* (Conrad) ---------- 133

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18 Umbonal region of a third specimen, with very heavy scars. x 1.5. (W. M. 33425)

19 Internal view of a brachial valve with exceptionally clear markings. x 1.5. (W. M. 33415)

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Brachial, anterior, lateral and pedicle views of the holotype. x 2. (W. M. 25638)

PLATE IV

FIGURE PAGE

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A composite series of sections illustrating the internal character of this form. x 5. (W. M. 25637)

7— 9 *Eurystomites robertsoni* (Hall) ---------- 139

7 A specimen preserving part of the living chamber. (W. M. 25971)

8 A tranverse section showing the siphuncle.

9 Drawing of the sutures on the inner side of the outer whorl of the same specimen. L. C., living chamber.

10 Surface slab from the Streptelasma bed; outer part silicified and porous, while the core (C) remains crystalline limestone. Described on ---------- 92 (W. M. 25935)

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FIGURE PAGE

1 *Eurystomites robertsoni* (Hall) ---------- 139

A specimen preserving most of the living chamber. The septa are drawn in from the opposite side of the specimen. (W. M. 25970)

2— 9 *Dinorthis deflecta gibbosa* n. var. ---------- 131

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6— 7 External and lateral views of a brachial valve. (W. M. 33403)

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1 Natural longitudinal section, nearly horizontal. The allotype. (W. M. 25968)

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4 Transverse section of another specimen, showing fusion of the siphuncle and shell wall. (W. M. 25964)

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1— 7 *Maclurites bigsbyi dixonensis* Ulrich ---------- 137

1— 3 Three views of a large operculum attributed to this form. Dotted line indicated the position of the muscular process. S, scars. (W. M. 33422)

4— 5 Two views of another operculum which shows both process and scars. P, process. (W. M. 33423)

6 Outline of a large natural cast, to show the outer angle of the whorls and size of umbilicus. (W. M. 25936)

7 Ventral side of the same specimen.

FORMS OF STROPHOMENA FROM BLACK RIVER AND RICHMOND FORMATIONS[1]

By CARROLL LANE FENTON

I. INTRODUCTION

In collections of fossils from the Plattin and Decorah formations of Ste. Genevieve County, Missouri, there were, in addition to the forms listed and described in previous papers, [2, 3] numerous specimens belonging to the brachiopod genus *Strophomena*. It soon was found that this material could be described only after comparisons had been made with species of the same genus from the Platteville and Decorah formations of the upper Mississippi valley, from Black River rocks of New York and Canada, and even from the Richmond strata of the Ohio valley. To include such a heterogeneous collection in a paper ostensibly dealing with the larger fossils of the Plattin formation clearly was impossible, and the material therefore was organized under a new title.

As the paper stands, therefore, it presents a description of "species," some of which are new, prefaced by a discussion of the taxonomy of Black River members of the genus *Strophomena*. That the conclusions reached in this discussion do not of necessity extend to all members of the genus is amply indicated by the fact that I have carefully examined but two species from that most prolific of all *Strophomena*-bearing horizons, the Richmond.

II. TAXONOMY

In descriptions of species of *Strophomena*, various characters have been stressed by different authors: shape of shell,

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1 Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 4.

2 Proc. Ia. Acad. Sci., vol. 29, pp. 67-84. 1923.

3 This journal, Vol. 11, pp. 86-96, and this issue pp. 125-143.

wrinkling of extremities, presence or absence of septum, flatness of umbo, etc. In this study, however, it soon became plain that some of these characters, no matter how significant they might be among Richmondian species, did not afford data for the determination of Black River forms.

An attempt therefore was made to evaluate the various characters already stressed by earlier authors, to discover others which might be significant, and to formulate working principles, or conclusions, as an aid to description. These last may be summed up as follows:

1. Shape of shell, among closely related forms, has little significance, particularly in Black River species; nor is its evidence apt to be conclusive even where significant. It always should be supplemented by other, and preferably internal characters.

2. Production and wrinkling of cardinal extremities are highly variable characters, apparently dependent upon environment and age (vide *S. musculosa*).

3. Characters of costae are of uncertain value, but deserve consideration.

4. Thickness of shell is significant only when it is accompanied by other characters, particularly those which indicate racial senescence. Mere thickness or thinness probably is traceable to environment.

5. The muscle scars and septa of the pedicle valve offer characters of major taxonomic value among the Black River forms of *Strophomena,* and probably in others. Shape of scars, width and thickness of ridges, margins and septa,—all display characters of considerable permanence. Variations in thickness of shell seem not to affect seriously the essential characters of either scars or septa.

The last conclusion was accepted with some reluctance. It is true that in his large paper on *Strophomena*,[4] Foerste indicated the importance of the pedicle muscle scars in several

4 Bull. Sci. Lab. Denison Univ., vol. 17, pp. 17-173, pls. 1-18. 1912.

forms, and they have been illustrated by many authors. But to assign these scars diagnostic value, while characters of shape, proportion and surface are regarded as secondary or even negligible, seemed at first a radical step. Also, it increased the difficulty of identifying specimens of *Strophomena;* for though good interiors of pedicle valves are not rare, they are less common than exteriors. Yet the loss is more apparent than real. On the basis of external characters, several forms which are different seem to be identical, and some which are identical seem different; and if internal features serve to correct such errors, one need not regret a few exteriors or molds that must go unnamed.

A few comparisons have been made to determine the relationships of the various forms described, but aside from the comments made in connection with *Strophomena vetusta* and *S. neglecta,* nothing can be said about evolution. Nor have I made any attempt to determine the proper taxonomic rank of the various forms described. In the first place, this cannot be done without a comprehensive and detailed study of the entire genus; in the second, it requires a certainty on the questions of taxonomic ranking which I do not feel. I have chosen, therefore, to take the course which best indicates this uncertainty and which offers the fewest obstacles to future revision, and have called each new form a species. In this sense the word is merely a convenient designation, without definite significance, and the binomials indicate no close relationships which some future student might find to be non-existent.

III. STATUS OF STROPHOMENA INCURVATA (SHEPARD) AND S. FILITEXTA HALL

Prominent among the identifications of Black River Strophomenas stand the species *S. incurvata* (Shepard) and *S. filitexta* Hall. Bassler[5] has given bibliographies of both,

5 U. S. Nat. Mus., Bull 92, vol. 2, p. 129. 1915.

and has expressed the opinion that *filitexta* is a synonym of *incurvata*.

Examination of literature, however, showed a wide variation in interpretation of the latter species and the reason for it: Shepard's description of his fossil is exceedingly indefinite, and his figures are unrecognizable. The specimens are said to come from Green Bay Wisconsin, a region where Ordovician rocks can occur only in drift. Attempts to secure such specimens have been futile, but from the location it may be concluded that the originals were not from rocks originally forming part of the Platteville formation. Nor does it seem possible, without specimens or recognizable figures, to say that the missing types were identical with forms from the East. The one satisfactory course is to abandon the species.

There remains *Strophomena filitexta* Hall, described from specimens found at Middleville, N. Y.[7] Although the types were supposed to be in the collections of the American Museum of Natural History[8], Dr. Reeds writes me that they are lost, and the museum has no other good specimens from the type locality. Nor are specimens to be found in the New York State Museum and the U. S. National Museum, where Doctors Ruedemann, Bassler and Ulrich have searched for them.

In considering the status of *S. filitexta*, little weight can be given to the figures in plates 9 and 9A of Volume VIII of the Paleontology of New York. They represent a miscellaneous array of specimens, none of which are from New York, and at least one (Fig. 12, Plate 9A), from the Richmondian of the Ohio valley. Two (Figs. 3 and 5, Plate 9), appear to be identical with *S. plattinensis* of this paper. Nor does it seem possible to accept the descriptions of other authors than Hall, since there is no assurance that these descriptions conform to the missing types.

From the examination these facts emerge: (1) *Stropho-*

6 Am. Journ. Sci., vol. 34, p. 144, figs. 1-2. 1838.
7 Pal. N. Y., vol. 1, p. 111, pl. 31B, figs. 3 a-f. 1847.
8 Am. Mus. Nat. Hist., Bull 11, pp. 38-39. 1898.

mena filitexta Hall cannot be considered a synonym of *S. incurvata* (Shepard), since the latter is not recognizable. (2) The *Strophomena filitexta* of Hall and Clarke is non-existent, having been applied to a varied array of specimens, of which none appear to be identical with the types. (3) *Strophomena filitexta* Hall is not so described as to be indentifiable without reference to specimens, which at present are lacking.

So far as this paper is concerned, there is no need to either accept or reject Hall's species. On the other hand, there seem no grounds for further use of the name unless it is applied to specimens from the type locality and (if possible) stratum, with adequate description and illustration. Certainly any student of Strophomenas of the East who cannot secure such specimens will be justified in disposing of Hall's species as unrecognizable.

IV. DESCRIPTIONS

STROPHOMENA AUBURNENSIS N. SP.

PLATE IX, FIGS. 1-3.

Description.—Shell of medium to large size; thin. Dimensions of one complete specimen and one pedicle valve: length 23.2 and 27.4 mm.; width 28.5 and 37 mm.; thickness 5.3 mm. and ——. One exceptionally convex brachial valve shows a thickness of 8.3 and a width of 34.3 mm.

Pedicle valve slightly convex umbonally. Cardinal area broad and acutely retrorse; deltidium strongly convex, about twice as wide as high. Teeth prominent and heavy, borne on the raised border of the muscular area. The latter is large and elevated, being divided into two lobes by a broad, rounded septum which begins 1 to 1.5 mm. anterior to the beak. Each lobe terminates anteriorly in a point. The shallow, linear adductor scars are on the septum; diductor scars striate, with sharp, elevated margins. The intramarginal thickening is crossed by numerous straight vascular sinuses. Entire inner surface finely tuberculate.

Brachial valve flattened umbonally, with slight median depression. Cardinal area narrow; beak small and pointed.

Cardinal extremities slightly crenulate and strongly deflected.

Surface of both valves marked by rounded, radiating costae which increase by implantation. Alternation distinguishable near the beaks, where every fifth to eighth costa is markedly larger than the rest. The concentric wrinkles are closely spaced and heavy; growth lamellae numerous and prominent.

Remarks.—This form is characterized by its thin shell, heavy lamellae and wrinkles, and by its symmetrical, sharply defined muscle scars in the pedicle valve. In no other *Strophomena* studied are the adductor scars so shapely, and so consistently terminated by high points; of the group described in this paper *S. auburnensis* is the most readily identifiable.

Occurrence.—Auburn chert, Lincoln County, Mo. Collected by Dr. Stuart Weller.

STROPHOMENA PLATTINENSIS N. SP.

PLATE X, FIGS. 7-9.

Strophomena filitexta Hall and Clarke, Pal. N. Y., vol. 8, pt. 1, pl. 9, fig. 3; perhaps fig. 5. 1892.

Description.—Shell large; cardinal extremities angular and deflected. Dimensions of two pedicle valves: length 27 and 26.6 mm.; width 41 and 37.2 mm.; thickness —— and 1.5 mm. Dimensions of two brachial valves: length 26.1 and 19 mm.; width 36 and 28.5 mm.; thickness 4.5 and 3.4 mm.

Pedicle valve convex umbonally, with beak rather prominent. Cardinal area narrow; deltidium prominent. Teeth not known. Muscular area large, strongly striate, containing faint adductor scars, on either side of which are the broad, elevated scars of the diductors. Genital markings not shown. Near the margins of the shell runs a broad, low thickening crossed by straight vascular sinuses.

Brachial valve slightly concave umbonally but elevated at the beak; moderately convex laterally and anteriorly. A broad, shallow mesial depression shows in some specimens. Cardinal area unknown. Internal characters shown by fig. 7 of plate 10.

Surface marked by fine, rounded, radiating costae which increase by implantation; they are crossed by closely spaced, rounded, concentric wrinkles which give the costae a nodose appearance. Growth lamellae prominent on the pedicle valve. Cardinal extremities more or less wrinkled in both valves, particularly the brachial.

Remarks.—This is one of the several species of *Strophomena* that have been referred to *S. incurvata*. There is little doubt that it is identical with the Mineral Point specimens of *S. filitexta* figured by Hall and Clarke.

Occurrence.—Platteville, Mineral Point, Wis.; Plattin of Ste. Genevieve County, Mo., becoming common in number 12 of the general section on South Beckett Hill, and continuing to the top. It is rare or lacking in the lower ten members.

STROPHOMENA WINCHELLI HALL AND CLARKE

PLATE IX, FIG. 8.

Streptorhynchus (*Strophonella?*) *deltoidea* Hall, 2d. Ann. Rep. N. Y. State Geol., pl. 39, figs. 10, 12-14. 1883. (Not fig. 11,—*S. nutans.*)

Strophomena winchelli Hall and Clarke, Pal. N. Y., vol. 8, p. 344, pl. 9, figs. 10, 12-14; pl. 20, fig. 26. 1892.

Strophomena winchelli Winchell and Schuchert, Geol. Minn., vol. 3, pt. 1, p. 394, pl. 31, fig. 11. 1893.

Description.—Shell of medium size, wider than long, with hinge-line produced. Dimensions of two Plattin specimens: length 23.6 and 21.5 mm.; width 31.4 and 24.6 mm.; convexity or thickness, 11 and 10.5 mm. In the second specimen the extremities are but slightly produced.

Pedicle valve convex umbonally, concave anteriorly, and reflected near the margins. Cardinal area moderately high and flat; delthyrium wide and but partly closed by the deltidium. Teeth low and strong. Diductor scars wide, flabelliform, sharply elevated. Adductor scars narrow, situated on a broad, rounded elevation that is larger in specimens from Missouri than in those from Wisconsin. Near the margins of

the valve a heavy ridge, crossed by vascular canals, appears and at the extremities fuses with the elevated posterior margin.

Brachial valve flat umbonally, very convex in the mesial region, and less so toward the margins. Two specimens show slight wrinkling near the cardino-lateral margins. Cardinal process consists of two short and slender apophyses which are united basally with the hinge plates. The latter are widely divergent, extending in broad curves subparallel to the hinge-line. Diductor scars narrow, situated on a narrow median ridge; adductors broad, flabelliform, with their margins slightly elevated.

Surface of both valves covered by fine, rounded costae which alternate regularly, though not conspicuously, in size. They are crossed by fine concentric wrinkles which are less marked than those of *S. plattinensis*. Growth lamellae not prominent.

Occurrence.—Platteville of Clifton and Janesville, Wis.; Plattin of Ste. Genevieve County, Mo. Winchell and Schuchert mention specimens from the Galena at Oshkosh, Wis.

STROPHOMENA DIGNATA N. SP.

PLATE X, FIGS. 3-5.

Description.—Shell medium to large. Dimensions of the allotype: length of pedicle valve, 25.7 mm.; length of brachial valve, 24.9 mm.; width 36.2 mm.; thickness 9.2 mm.; height of cardinal area 2.6 mm.

Pedicle valve convex umbonally, strongly concave medially, and reversed on the extremities. These are produced and moderately crenulate. Anterior margin nasute. Cardinal area flat; delthyrium wide, deltidium highly convex. Intramarginal ridge low and rounded, and crossed by fine vascular canals. The muscular area is elongate flabelliform, with high, sharp boundaries and sharp, radiating ridges on the diductor scars. Adductor scars linear, situated on a low elevation which expands posteriorly but fails to reach the umbonal

region. Teeth strong and high; genital area pustulose.

Brachial valve flattened umbonally, strongly convex medially, reversed on the moderately wrinkled extremities. Internal characters not known.

Surface marked by irregularly alternating costae, from 3 to 5 fine ones to each coarse. The concentric wrinkles are fainter than in *S. musculosa.*

Remarks.—*Strophomena dignata* is closely related to *S. musculosa,* and it is possible that both are regional variations of the same species. On the other hand, a number of variations of *dignata* within the Ste. Genevieve area argue against this.

Occurrence.—Decorah formation, two and a half miles west of Ste. Genevieve, Mo. Collected by Dr. Stuart Weller.

STROPHOMENA EXIGUA N. SP.

PLATE X, FIG. 6.

Description.—Of this form but two pedicle interiors are known. Their measurements are: length 29.7 and 26.1 mm.; width 36.2 and 32.3 mm. The cardinal extremities are slightly produced, while irregular curvature of the anterior and lateral margins gives the shell a rectangular appearance. Cardinal area high; deltidium strongly convex; teeth heavy.

The diagnostic feature of *S. exigua* is a Y-like ridge formed by the septum bearing the adductor scars and two ridges which extend from it to the plates supporting the teeth. A slightly similar structure is seen in *S. plattinensis,* where both ridges and septum are very indistinct, and the former incomplete; and in one of Hall and Clarke's figures of *"S. filitexta."* (Pal. N. Y., vol. 8, pt. 1, pl. 9, fig. 5.) Dr. John H. Bradley, Jr., tells me that a similar structure is found on one of the Kimmswick Strophomenids.

Occurrence.—Rare in the upper part of the Plattin, South Beckett Hill, Ste. Genevieve Co., Mo. The types are from number 41 of the general section.

STROPHOMENA MUSCULOSA N. SP.

PLATE VIII, FIGS. 1-7.

Description.—Shell large, wider than long. Dimensions of the allotype and two paratypes: length of pedicle valve 28.2, 22 and 16 mm.; length of brachial valve 27.4, 21.5 and 15.9 mm.; width 39, 36 and 22.3 mm.; thickness 12.7, 8 and 6.5 mm.; height of cardinal area 3.6, 4.1 and 1.8 mm.

Pedicle valve convex umbonally, strongly concave medially, with cardinal extremities reversed. In old specimens they are slightly produced. Cardinal area flat, high, bearing a wide delthyrium whose deltidium fails by 1 mm. or more to close its opening. Cardinal area weakly striate, the striae being indistinguishable in some specimens. Extremities smooth in young individuals, becoming progressively crenulate as the shell enlarges and thickens. Diductor scars broadly flabelliform, with heavy, elevated margins and strong, radiating ridges separated by deep grooves. Adductor scars borne on a low, rounded elevation which in some specimens extends beyond the muscular area. Genital region sharply pustulose. Intra-marginal ridge low and broad. Teeth heavy and prominent.

Brachial valve moderately convex in young shells, becoming highly so in old ones; its curvature is reversed at the extremities. Like those of the pedicle valve, these are progressively wrinkled. Diductor scars narrow, elevated; adductor scars broad, ridged, and without definite margins. Cardinal process bifid and heavy; hinge plates wide, enclosing deep sockets.

Surface marked by radiating costae which increase by implantation. They show irregular and inconspicuous alternation, and are crossed by concentric wrinkles, as well as growth lamellae.

Remarks.—This probably is the shell from Fountain, Minn., which Winchell and Schuchert identify as *Strophomena billingsi.* That name, however, they apply particularly to *S. recta* of Billings, reproducing his original figure. This shows

a depressedly biconvex shell with very coarse costae. None of the Fountain specimens are biconvex, and even the coarser of their striae number 15 to 20 in the space of 5 mm. There seems no reason, therefore, for concluding that they are equivalent to *S. recta* Billings.

The closest relationships of *S. musculosa* seem to be with *S. dignata* of the Decorah of Missouri, and *S. neglecta* of the Richmond. Close similarities appear in the markings of the surface, in the shape and thickness of shell, and in the shape of the muscle scars in the pedicle valve. The relationship is discussed under the heading of *S. neglecta*.

Occurrence.—Decorah formation, Fountain, Minn.

STROPHOMENA SP.

PLATE IX, FIG. 7.

Remarks.—In the Decorah material collected by Dr. Weller are specimens of a rather large *Strophomena* whose brachial valve is highly convex, whose extremities are neither produced nor wrinkled, and whose costae are crossed by weak concentric wrinkles. In general type the shell is distinct; but since there are no interiors which may be reliably associated with the brachial exteriors, description as a species is unjustifiable.

STROPHOMENA INCONSUETA N. SP.

PLATE X, FIGS. 1-2.

Description.—Of this form only pedicle valves are known. Dimensions of the two types: length 22.4 and 23.1 mm.; width 27 and 28.3 mm.; thickness (concavity) 2 and 2.3 mm.

Valve subquadrate in outline, with extremities sharp but not produced. Muscular area broad, flabelliform, not much elevated along its margins, and depressed posteriorly. Diductor scars broad, faintly ridged, and indefinitely terminated anteriorly, since the bounding ridges give rise to others that extend beyond the scars. Adductor scars on a low, indistinct ridge.

Surface marked by rounded costae, every fourth (rarely, third) of which is heavier than the others. Commonly there is secondary alternation, the middle of the three lesser costae being thicker than the others.

Remarks.—The shape, surface characters, and muscle scars of this form seem to warrant its description; though rare it should prove readily identifiable.

Occurrence.—Upper part of the Plattin, South Beckett Hill, Ste. Genevieve Co., Mo.

STROPHOMENA DELICATULA N. SP.

PLATE IX, FIGS. 4-6.

Description.—Shell of medium size. Dimensions of the holotype and two other specimens: length of pedicle valve 21.5, 23 and 23 mm.; length of brachial valve 19.6 and 21.8 mm.; width 25.8, 27.8 and 31.5 mm.; thickness 4.5, 6 and 7.2 mm.; height of cardinal area 2.7, 2.9 and 3.2 mm.

Pedicle valve convex umbonally, flattened medially and postero-laterally and concave antero-centrally. Extremities with curvature reversed; in some specimens they are wrinkled, but in others smooth. Cardinal area without vertical striae. Brachial valve moderately convex, flattened umbonally, with the extremities reversed and commonly wrinkled. Surface marked by irregularly alternating costae which, on the anterior margin, number 17 to 25 in the space of 5 mm. The alterations are more marked on the pedicle valve than the brachial, there being 3 to 5 fine costae for every coarse one. Concentric wrinkles strong and closely spaced; growth laminae infrequent.

To this species have been assigned a series of delicate, depressed pedicle interiors whose surface characters are in doubt. The intramarginal ridge is low and weak, the vascular channels straight and narrow, and the genital area nearly smooth. The diductor scars are acutely flabelliform, with sharp boundaries; the linear adductor scars are on a narrow septum. Teeth are low and weak. Two specimens from the

Decorah of Minnesota show similar characters but are much larger, with produced extremities. Unfortunately, their muscular regions are poorly preserved.

Remarks.—This form suggests thin specimens of *S. vetusta* (James) of the Richmond in general appearance, though its size is much less. If the association of pedicle interiors with exteriors is correct,—and there seems little reason to doubt that it is—the resemblance is borne out by the muscle scars.

Occurrence.—Decorah formation, two and a half miles west of Ste. Genevieve, Mo. Collected by Dr. Stuart Weller.

STROPHOMENA VETUSTA (JAMES)

PLATE IX, FIGS. 9-11.

Streptorhynchus (*Strophomena*) *vetusta* James, Cin. Quart. Journ. Sci., vol. 1, p. 241. 1874.

Strophomena vetusta Foerste, Bull, Sci. Lab. Denison Univ., vol. 17, p. 98, pl. 6, figs. 2 a-h. 1912.

Remarks.—This species, typical of the Waynesville and Liberty members of the Richmond, is illustrated here because of its resemblance to *S. delicatula* of the Decorah. Attention already has been called to the similarity in surface markings, and shape; comparison of figures of pedicle interiors will show that the relationship also is indicated by the muscle scars.

The kinship of these Decorah and Richmond types of *Strophomena* substantiates the observations made on *Zygospira* and other fossils from the same horizons. The Decorah fauna is markedly like that of the Maquoketa, a Richmondian formation of Iowa and Minnesota; it now appears that a similar, though perhaps less marked relationship exists between the Decorah fauna, and that of Richmondian strata in the Ohio valley.

This relationship, moreover, modifies the one which might be inferred to exist between *S. vetusta* and *S. vetusta praecursor* Foerste of the lower Waynesville. With the *S. vetusta* type established in the Black River, it is doubtful that the

variety *praecursor* is genetically what its name implies. Unfortunately, few general principles have been established for Strophomenid evolution, to furnish a court of appeal when stratigraphic evidence is not conclusive. However, the thick shell, strong internal markings, and weakening costae of the variety *praecursor*, when compared with similar characters in other brachiopods, indicate an aging form rather than a youthful one; a terminal rather than an ancestral position.

Should this interpretation be correct, the following series of events may be postulated: The *S. vetusta* type reached the Mississippi basin during the middle Black River epoch (late Plattin or earliest Decorah) in the form of *S. delicatula;* it disappeared during the Cincinnatian proper, but like many other Plattin types, did not become extinct. In the Richmondian it appeared first in the aberrant, senescent form *S. vetusta praecursor*, which gradually gave way before the true *S. vetusta*, a modified but not radically changed representative of the Black River line.

STROPHOMENA NEGLECTA (JAMES)

PLATE VIII, FIGS. 8-9.

Streptorhynchus neglecta James. Paleontologist, no. 5, p. 41. 1881.

Strophomena neglecta Foerste, Bull. Sci. Lab. Denison Univ., vol. 17, pl. 5, figs. 1-3; pl. 7, fig. 5; pl. 9, fig. 1; pl. 11, fig. 10. 1912.

(For additional bibliography see Bassler, Bull. 92, U. S. Nat. Mus.)

Remarks.—Like Strophomena vetusta, the species *neglecta* of the Richmond is included here for comparison with forms found in the Decorah—*S. dignata* and *S. musculosa*.

In general shape, *S. musculosa* resembles *S. planumbona* of the Richmond as closely as it does the typical, thick-shelled *S. neglecta*. The alternations of striae, however, place it in the group of the latter; and this relationship is apparent also in the internal characters of the pedicle valve. Although

there are striking differences, such as larger diductor scars and absence of pustules in the Decorah form, the general similarities are made clear by the photographs.

It is these same internal characters which furnish data on the relative racial ages of the two species. From shape alone *S. musculosa* might well be considered more clearly senescent than *S. neglecta;* but the heavy, elaborate muscle scars of the latter show the contrary to be true. Both *neglecta* and *musculosa,* in turn, are radically older than *S. dignata* of the Missouri Decorah. The group forms another example of the intimate relationship existing between elements in the faunas of the Decorah and Richmond.

EXPLANATION OF PLATES

PLATE VIII

FIGURE		PAGE
1— 7	*Strophomena musculosa* n. sp.	153
1	Interior of a pedicle valve, the holotype. (W. M. 25524)	
2	A paratype with heavy scars. (W. M. 25527)	
3	A small paratype bearing strong growth lamellae. (W. M. 33421)	
4	A young individual resembling the one of Fig. 6, but with non-crenulate extremities. (W. M. 33421)	
5	Interior of a brachial valve. (W. M. 25527)	
6— 7	Pedicle and brachial views of a large specimen, the allotype. (W. M. 25525)	
8— 9	*Strophomena neglecta* (James)	157
	Interiors of two large, well-marked pedicle valves, for comparison with Figs. 1—2. (W. M. 25544)	

PLATE IX

FIGURE		PAGE
1— 3	*Strophomena auburnensis* n. sp.	148
1	Interior of a pedicle valve, the holotype. (W. M. 25521)	
2	Brachial view of the allotype. (W. M. 25522)	
3	Surface of the pedicle valve of the allotype, near beak, x 3.	
4— 6	*Strophomena delicatula* n. sp.	155
4	Brachial view of the allotype. (W. M. 33400)	
5	Pedicle interior, the holotype. (W. M. 25537)	

6 A large pedicle valve, referred with doubt to this form. (W. M. 25538)

7 *Strophomena* sp. ---------- 154
Brachial valve of a large, highly convex *Strophomena* from the Decorah of Ste. Genevieve Co., Mo. (W. M. 25543)

8 *Strophomena winchelli* Hall and Clarke---------- 150
Interior of a typical pedicle valve, Plattin of Ste. Genevieve Co., Mo. (W. M. 25513)

9—11 *Strophomena vetusta* (James)---------- 156

9 Interior of a pedicle valve, one of the cotypes. (W. M. 25545)

10—11 Brachial and pedicle views of a large, typical specimen. (W. M. 1567)

PLATE X

FIGURE PAGE

1— 2 *Strophomena inconsueta* n. sp.---------- 154

1 Interior of a pedicle valve, the holotype. (W. M. 25987)

2 Exterior of a typical pedicle valve. (W. M. 25989)

3— 5 *Strophomena dignata* n. sp.---------- 151

3 Brachial view of the allotype. (W. M. 25533)

4 Interior of a pedicle valve, the holotype. (W. M. 25532)

5 Interior of an elongate pedicle valve. (W. M. 25535)

6 *Strophomena exigua* n. sp. ---------- 152
Interior of a pedicle valve, the holotype. (W. M. 25956)

7— 9 *Strophomena plattinensis* n. sp. ---------- 149

7 Interior of a pedicle valve, the holotype. (W. M. 25988)

8 A small paratype with coarse costae. (W. M. 25501)

9 A large brachial valve, wrinkled at the extremities. (W. M. 25983)

A NEW SPECIES OF SCHIZOPHORIA FROM THE DEVONIAN OF IOWA[1]

By MILDRED ADAMS FENTON AND CARROLL LANE FENTON

For some years we have been familiar with a member of the genus *Schizophoria* which, in the reports of the Iowa Geological Survey, commonly has been referred to *S. mcfarlanei* (Meek). Careful comparison with Meek's figures, however, show the reference to be incorrect, while comparison with other described species of the genus from America and Europe indicate that the Iowa form, whatever its proper taxonomic rank, is distinct. Accordingly, we submit this description of it, with the name of the author with whose species it most often has been confused: Meek.

SCHIZOPHORIA MEEKI N. SP.

PLATE XI, FIGS. 1-8.

Orthis (or *Schizophoria*) *mcfarlanei* auctt.

Not *Orthis mcFarlanei* Meek, Trans. Chicago Acad. Sci., vol. 1, pt. 1, p. 88, pl. 12, fig. 1. 1868.

Description.—Shell of medium size, with length and width about equal in adult specimens. Dimensions of the holotype, (which is an incomplete brachial valve), a normal specimen, and an unusually tumid one: length of pedicle valve ——, 24.6 and 25.3 mm.; width 26.6, 25.3 and 22 mm.; thickness ——, 21 and 20 mm.; length of hinge line 14.8, 15.5 and 11.4 mm.

Pedicle valve markedly convex umbonally, sloping gently to the cardinal, and still more gently to the anterior margins. Sinus appears only as a broad, shallow depression in the anterior half of the valve. Beak sharp, slightly incurved;

1 Contributions from the University of Cincinnati Museum. Geology and Paleontology. Number 5.

cardinal area broadly triangular, with an average height of about 3 mm.

Brachial valve very highly convex, particularly in senescent and narrow specimens. Umbo produced slightly beyond the cardinal margin; beak blunt and slightly incurved; cardinal area broadly triangular. In most specimens there is no mesial fold; a few show a depression. Internally, the cardinal process is small and angular, with sharp lateral ridges; it extends forward about 2 mm. Crural plates heavy, and less widely divergent than in many members of the genus; in the holotype their length is 3.5 mm. Dental sockets deep; muscle scars deep, with strongly elevated margins, their general character being shown adequately by Fig. 1. Vascular sinuses deep; in the holotype they extend more than two-thirds of the distance to the anterior margin.

Remarks.—As has been said, this form commonly has been confused with *S. macfarlanei* (Meek), from which it differs in its greater proportionate length, narrower hinge-line, more rounded lateral margins, and finer costae. In general, specimens from the lower Cedar Valley ("Upper Wapsipinicon") resemble the Canadian species more than do those from higher beds.

Occurrence.—Acervularia? profunda zone of the Cedar Valley stage, particularly in the neighborhood of Waverly, Iowa; also in strata which we consider to be of Cedar Valley age at Solon, Iowa, where it is common in beds characterized by *Atrypa independencis* Webster.

Holotype.—No. 25,993; *Paratype.*—No. 7465, Walker Museum; *Allotype.*—No. 347; *Paratype.*—Nos. 348-350, University of Cincinnati Museum.

PLATE XI

FIGURE		PAGE
1— 8	*Schizophoria meeki* n. sp.	160
1	Internal view of the holotype, showing the thick shell, heavy muscle scars and deep vascular sinuses. Waverly, Ia. (W. M. 25993)	
2	Brachial view of a paratype. (W. M. 7465)	
3— 5	Brachial, posterior and lateral views of a thick, narrow paratype. The shell was much worn before fossilization, and the drawings purposely obscure many of its irregularities. Solon, Ia. (U. C. M. 348)	
6— 8	Lateral, brachial and posterior views of the Allotype, in which the cardinal area is exceptionally high. Solon, Ia. (U. C. M. 347)	

Book Review

TARKA THE OTTER;
By Henry Williamson—
E. P. Dutton & Co., New York.

The naturalist, the litterateur, and even the lover of thrills will pay this book the tribute of more than one reading. This is to say that it has an appeal for more than the specialist. It is also to say that the author has combined the qualities of a trained observer, a meritorious sense of literary values and a fetching human appeal. Though the fascinating story of Tarka the Otter is the purpose of the book, Mr. Williamson may be said to have included in it a word story of every minute thing that Tarka touched upon in his adventurous career. The salt of the sea, as well as the tree-laced river and the murmurous meadow, has each its turn in delighting the reader. And over it all hangs the breathless suspense of the life long conflict between Tarka the Otter and Deadlock, the hound. The temptation to quote comes too often for the space allotted for review and the fear of passing over one excellence for another. As an example of literary economy, however, witness this, so reminiscent of Celtic brevity: *"White-tip awakened before Tarka by the time of an eye-blink."* Or this that betrays the patient lover of nature: *"Uch, uch!* gasped the seal, exhausted and aching after her anguished journey over the boulders of the cavern. She had hurried by pressing the palms of her flippers on the ground and lifting her body forward by short jumps, moving fast as a walking man. She reached her cub and caressed it with her tongue, making sounds over it between sobbing and bleating. Then she turned

her back to the man, and flung sand and pebbles at him with quick scooping strokes of her flippers. The man took from his pocket a wooden whistle, made from an elderberry stick, and played several soft notes upon it. The seal looked at him, enjoyed the rude music. She lay still and happy with her calf, whose head was turned on one side as it sucked through the side of its mouth. The man played on, moving nearer to the seal. Slowly he bent down to stroke its head, and the seal licked his hand." Or this that is so human in the final conflict: "At the beginning of the eighth hour a scarlet dragonfly whirred and darted over the willow snag, watched by a girl sitting on the bank. Her father, an old man and humped as a heron, was looking out near her. She watched the dragonfly settle on what looked like a piece of bark beside the snag; she heard a sneeze, and saw the otter's whiskers scratch the water. Glancing round, she realized that she alone had seen the otter. She flushed, and hid her grey eyes with her lashes. Since childhood she had walked the Devon rivers with her father, looking for flowers and the nests of birds, passing some rocks and trees as old friends, seeing a Spirit everywhere, gentle in thought to all her eyes beheld."—*L. V. B.*

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